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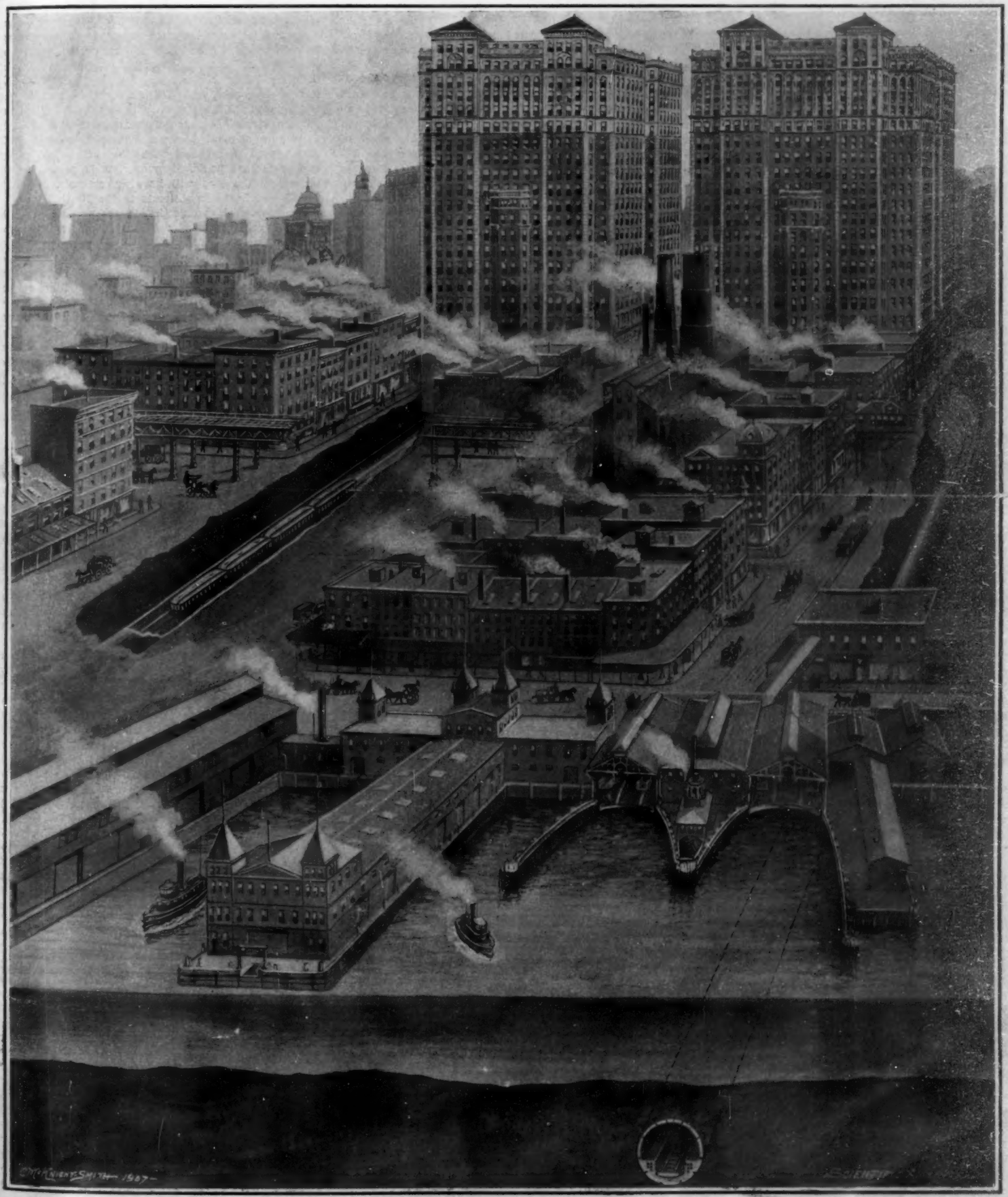

The trains from Jersey City will enter Manhattan by the tube shown in the foreground. The single track will diverge into five tracks, which will swing to the left and enter a six-platform station below the large building shown in the background. This building, 22 stories high, will be nearly three times larger than any existing office building and will house 20,000 people. Trains return to Jersey City by the tunnel shown at the left of building.

HUDSON COMPANIES' GIGANTIC TERMINAL STATION FOR THE HUDSON RIVER TUNNEL AT CORTLANDT STREET.—[See page 88.]

SCIENTIFIC AMERICAN
ESTABLISHED 1845

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NEW YORK, SATURDAY, JANUARY 26, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE COMEDY OF THE MANHATTAN BRIDGE.

Is there not a strong element of the ridiculous in the present hysterical attempts to solve the problem of the Brooklyn Bridge congestion by building a three-and-a-half-million-dollar station and a thirteen-million-dollar subway—provisions which can merely modify and never cure the evil—when the whole congestion could be relieved by building the Manhattan Bridge, whose construction was authorized nearly ten years ago? The Brooklyn Bridge is crowded to its maximum capacity, if not beyond it. Eight or ten years ago the crowding had begun, and to provide for the present congestion, which was even then foreseen, the city did the obviously best thing, namely, authorized the building of another bridge within a quarter of a mile of the Brooklyn structure, the capacity of the new bridge being fifty to sixty per cent greater than that of the old bridge. Plans were drawn up, and everything was ready for a vigorous prosecution of the work, when the politicians got hold of the enterprise, deliberately stopped the work, and have been playing football with this, the most badly-needed municipal work of the day, ever since.

The SCIENTIFIC AMERICAN has kept the public pretty well informed of the course of this disgraceful fiasco, and less than a year ago, wrote an open letter to the present Mayor, respectfully calling his attention to the delay, and asking that he use his authority to expedite the building of the bridge—a communication which proved of so much interest to His Honor, that he has not yet found time to acknowledge its receipt.

Although the piers for the Manhattan Bridge were completed, ready for the erection of the steel, four or five years ago, not a pound of structural material has been erected even at this late day. Meanwhile, instead of going ahead with the new bridge, which would bring instant and abundant relief, the city officials, from the Mayor down, have been worrying about the best kind of a terminal station to build at the Manhattan end of the old bridge. The plans have been drawn for a structure which would seem to be capable of handling at least twice as much traffic as the old bridge can ever bring into it.

As if to make the folly more complete, the city has now authorized the construction, between the Williamsburg and Manhattan bridges, of a subway loop into which the cars of the Brooklyn Rapid Transit, not being suitably constructed for subway service, can never enter. When the subway is completed, the cars of the most important branches of the Brooklyn system of transportation will be barred from its use.

We have always believed, and still do, that a temporary elevated loop, usable by the elevated cars of the Brooklyn Rapid Transit, should have been built and used, until such time as the subway loop could have been constructed, and the Brooklyn Rapid Transit equipped with cars suitable for subway service.

MR. HILL ON THE RAILROAD CRISIS.

In the course of a recent letter to the Governor of the State of Minnesota, James J. Hill, who unquestionably understands the railroad situation better than any other man in the country, makes a masterly analysis of the recent report of the Interstate Commerce Commission, and proves that the present alarming congestion in railroad traffic is the inevitable outcome of the disparity between the enormous increase in traffic and the relatively small mileage of new railroad track which has been built to meet it. The letter is remarkably devoid of theory and speculation; it deals with the cold facts and figures of the Interstate Commerce reports, and the analysis and deductions are so clear and convincing that he who runs may read.

In proof of his statement that of late years, although the volume of business has increased enormously, there has been built a relatively decreasing amount of track and terminal facilities, Mr. Hill compares the statistics of the growth of railroad business in the ten years from 1895 to 1905. During that decade the track mileage increased from 180,667 miles to 218,101 miles, or 21 per cent. But during the same time the passenger mileage increased from 12 billion miles to nearly 24 billion miles, or 95 per cent, and the freight-ton mileage from 85 billion ton-miles to 186 billion ton-miles, an increase of 118 per cent.

The above figures are even more alarming than they look to be; for within the ten years above mentioned, there has been a steady increase in the annual percentage of increase of each year over the preceding. Thus in the ten years 1870 to 1880, the per cent increase per annum in the total mileage of track was 7; from 1880 to 1890 there was a 7.46 per cent increase; but from 1890 to 1904 the increase fell to 2.19 per cent, and in the two years 1904 to 1906 the increase has fallen to 1.45 per cent per annum.

The situation is tersely summed up by Mr. Hill when he says that the limit of service of a common carrier has been reached when it has moving at all times over its systems as many cars as can be run on its tracks with safety, and transferred and dispatched from its terminals and junction points without unreasonable delay. Beyond that point, increase of business cannot be handled by increasing the number of cars and engines. The disparity between the growth of traffic and the additions to railroad mileage and extension of terminals, shown by a new mileage of less than 1½ per cent since 1904, to take care of a traffic increase averaging 11 per cent a year for ten years past, presents and explains the real problem. That the railroads have been making strenuous efforts to meet the clearly foreseen crisis is shown by the facts that, not only were there 25 per cent more locomotives and 45 per cent more cars in service in 1905 than in 1895, but each engine and car did much more work. The passenger miles traveled per locomotive increased more than 68 per cent, and the ton miles per freight locomotive increased more than 57 per cent.

The remedy proposed by Mr. Hill is staggering in its proportions and cost. He states that the best judgment of many conservative railroad men in the country is, that an immediate addition of not less than 5 per cent per annum should be made to the railroad trackage of the country for the next five years. For modern requirements, the additional track and the needed terminal facilities would cost not less than $75,000 per mile; that is to say, the cost of the new work would amount to a total of five and one-half billion dollars, or a yearly average of one and one-tenth billion dollars. Two remedies are proposed. For the reason that any considerable enlargement of the present terminal facilities in the city is absolutely prohibited by the enormous cost of real estate, the terminal congestion will have to be met by a decentralization of traffic. New centers for the transfer and forwarding of freight must be secured at points where land can be bought in adequate quantities and at a reasonable cost. Furthermore, there must be an all-round decentralization of traffic, with more points for export and more interior markets. Mr. Hill suggests that a 15-foot canal or channel from St. Louis to New Orleans would do more to relieve the middle West and Southwest than any other work that could be proposed.

In this, as in all great crises, it is essential that there should be harmonious co-operation in working out the solution. Although the railroads, or many of them, have unquestionably shown in the past too little inclination to strike a fair balance between their own interests and those of the general public, we believe that the fault has by no means lain entirely with the railroads. Mr. Hill says truly that it was not by accident that railroad building has declined to its lowest within a generation at the very time when all other forms of activity have been growing most rapidly. The investor declines to put his money in enterprises which are under the ban of unpopularity, and even threatened with confiscation and transfer to the State. This feeling must be removed, and greater confidence mutually established, if any considerable portion of the vast sum necessary to meet the crisis is to be available for the work.

BROOKLYN BRIDGE TERMINAL STATION AND SUBWAY LOOP.

The new Brooklyn Bridge Terminal, for which the Board of Estimate has recently appropriated three and a quarter million dollars, will be nearly three blocks in length and probably six or seven stories in height. The present terminal at City Hall Park will be completely removed, and it will then be possible to obtain from the City Hall an unobstructed view of the bridge structure and of the Brooklyn shore beyond.

To enable the surface cars to reach their own station, which will extend for two blocks north and south, and will be entirely below ground, North William Street will be closed, and the roadways on which the trolley cars run will commence to the east of William Street on an easy descent, which will bring them down below surface level without interfering with street traffic. The elevated trains will be loaded and unloaded at two different levels within the station, the first of which will be one story and the second two stories above the street surface.

It is not to be expected that the station will cause any material increase in the number of cars or trains that can be run across the Brooklyn Bridge, which is already crowded to its maximum capacity. The advantage of the terminal station, which will extend north from the present terminal as far as the junction of Duane and Center Streets, is that traffic will be more completely organized, the passengers who take the surface cars being distributed to the proper platforms reserved for each particular line of travel. Furthermore, it will be possible to permit trains from all sections of Brooklyn to cross the bridge without change during the rush hours.

The Subway loop, which has been authorized by the Board of Estimate, begins at the Williamsburg Bridge plaza in Brooklyn, crosses that bridge to Manhattan, and extends below Delancey Street to Center Street, beneath which it runs to the Manhattan Bridge. After crossing that bridge to Brooklyn, it runs by way of the new Flatbush Avenue extension—Fulton Street, Lafayette Avenue, and Bedford Avenue—back to the Williamsburg Bridge plaza. In Manhattan the line will be carried southerly below Center and William Streets to a point between Maiden Lane and Wall Street, with an eventual connection with Brooklyn by one or more tunnels. Moreover, it is probable that ultimately the loop will have an extension through Grand and Desbrosses Streets to the North River.

The most serious objection to the proposed loop is that the cars of the elevated roads of Brooklyn are not built of that fireproof construction which is considered to be necessary for the safe operation of a modern subway, and therefore they could not be sent through Manhattan by way of the loop. Had a temporary elevated loop been built, its construction could have been rapidly completed, and the Brooklyn elevated cars have made immediate use of it. Meanwhile, the construction of the permanent subway might have been undertaken, and special cars constructed by the Brooklyn roads for service by way of the loop.

A NEW ELECTRIC LAMP FILAMENT.

After seven years' research by Prof. H. C. Parker and Mr. Walter G. Clark, of Columbia University, these gentlemen have discovered and perfected a new incandescent lamp filament that is a marked improvement over the usual carbon filament both in the quality of light produced and the economy and life of the lamp. The inventors have christened their new filament the "Helion," on account of the resemblance of the spectrum of the light produced by it to the solar spectrum.

The new filament is composed chiefly of silicon, which is reduced and deposited upon a very thin carbon coil similar to that used in the ordinary incandescent lamp. The completed filament is mounted on a base in an exhausted bulb like those ordinarily used.

The Helion filament is remarkable in several respects. Foremost among these is the white quality of the light, which is obtained at a comparatively low temperature and with a consumption of electrical energy of but one watt per candle power produced. The new filament, while non-metallic, produces the unit of light with the unit of electrical energy at a much lower temperature than do some of the more recent metallic filaments when giving like results. The consumption curve in watts per candle is practically a straight line from 1,575 deg. C. (3½ watts per candle) up to 1,730 deg. C. (1¾ watts per candle). From this point on the curve gradually flattens until, at 1,800 deg. it is a horizontal line corresponding to a consumption of but one watt per candle power. Each filament has a point of maximum candle power, and increasing the current beyond that normally used at this point does not increase the candle-power. Filaments have withstood 100 per cent overload of current beyond the point of maximum brilliancy without rupture. The amount of overload one of the new filaments will stand was forcibly demonstrated by mounting one of them in a bulb on two pieces of copper wire several times greater in cross-section than the filament. The filament withstood without damage a current that fused the wire. Comparison between the luminosity of a Helion filament lamp and that of an ordinary incandescent shows that the former produces three and one-half times more light with the expenditure of considerably less energy at the point of greatest luminosity, which corresponds to the same wavelength for each. The high efficiency of the Helion filament is thought to be due largely to selective radiation, for although an increase in temperature above 1,720 deg. increases the intensity of the light, it does not make much change in its color, as is the case with the usual carbon filament lamp.

The life of the new filament appears, from the few tests which have thus far been made, to be comparatively long. The extremes of eight lamps tested were 485 and 1,270 hours. The short-lived lamp showed a decrease in candle power of 15 per cent, while the

long-lived one fell off only 3 per cent. One lamp that burned 735 hours showed a gradual increase in candle power of 2 per cent. The long-lived lamp mentioned showed an increase in candle power for the first 400 hours, followed by a gradual and slight falling off in candle power for the balance of its life. Starting with 37 candle power and 37 watts, after 200 hours this lamp began to show an increase in candle power without, however, any increase in current. At the end of 400 hours the candle power had run up to 40. During the next 100 hours it fell again to 37, and then declined gradually to 35½ at the end of 1,230 hours, while the consumption was diminished about half a watt. As these lamps that were given a life test were rather crudely made in the laboratory, and as they had been submitted to tests of various kinds before undergoing it, this probably accounts for the non-uniformity of the results obtained. The break in the filament occurred at the same place in each lamp, i. e., near the cement terminals, and it was due, the inventors believe, to a cause which can be corrected when the lamp is made commercially. Filaments of 30 candle power have been made for voltages of from 100 to 115 and of about the same length as the carbon filament of the ordinary lamp.

From the foregoing description of the Helion filament and the tests which have been made with it, one can see that it is apparently a very marked improvement over the filament now generally used, giving as it does approximately twice as much light with half the current consumption, and furnishing a much whiter light at that. The fact that it can be used in the ordinary vacuum lamp bulb is a point in its favor, as it can thus be readily employed wherever the ordinary incandescent lamp is at present in service.

THE JAMAICAN EARTHQUAKE.

From the meager details available at the time of this writing, it would appear that the recent earthquake which destroyed Kingston, Jamaica, was hardly less destructive in severity and extent than that which resulted in the destruction of San Francisco, or the subsequent one which effected such terrible devastation at Valparaiso. The past twelvemonth has been signalized by a series of natural phenomena which have been seldom equaled in any similar period within the history of mankind. Beginning with the terrible volcanic outburst of Vesuvius, various points of the earth's surface have been convulsed by volcanic outbursts or earth tremors, which have had the most disastrous effect, and have resulted in great loss of life and vast destruction of property. These various cataclysms have not occurred, furthermore, in a single so-called volcanic or earthquake belt. They have taken place in the most widely-separated localities, and our seismologists have not been able to ascribe their origin satisfactorily to a common cause. Whether or not it is merely coincidence that these happenings should all have taken place within a twelvemonth, or whether there is some great underlying action with which we are unfamiliar, and which has given rise to them, is still unexplained.

From the information at hand, it seems that the earthquake which destroyed Kingston consisted of a great number of shocks, with a shock of maximum intensity near the beginning of the series of tremors. The light architecture prevalent in the southern city was poorly adapted to resist a convulsion of this character, and even more substantially-built edifices collapsed under the exceptional severity of the earthquake. The usual accompaniment of tidal wave and Stygian darkness due to dust was present in this case too, and added to the general horror of the situation. It has been estimated that hundreds of lives were lost and that the damage to property will be found to reach many millions of dollars. The bottom of the harbor has sunk many feet, and there is danger, apparently, that the entire city—or rather what is left of it—may gradually sink into the sea.

While we are reluctant to ascribe a common origin to all these recent seismological phenomena, there may be some cause beyond our knowledge which has compelled vast internal changes in the structure of the earth, resulting in these alteratfons and readjustments upon the surface thereof. For instance, such cause might be found in the recent sunspot maximum. It must be remembered that a slip of a few inches only in rock strata which are poorly balanced or under heavy strain is sufficient to cause an earthquake of the greatest extent and intensity.

Prof. John Milne, the great English seismic authority, has advanced a theory to account for recent disturbances of this character manifested here and abroad in various parts of the world, which has been held tenable by Sir Norman Lockyer and Prof. Archenbold. Prof. Milne declares that the disturbances are due not to a merely normal readjustment of the earth's strata or to the shifting of the surface to meet a gradual contraction in the size of the globe, but are caused by displacement of the globe itself from its true axis and are really due to the jar incident to the subsequent swing back of the earth upon that true axis. It is conceivable that such a return movement to the axis as well as the original distortion would cause a tremendous strain upon the crust, and could easily account for the most terrific seismic convulsions imaginable. Sir Norman Lockyer declares further that the deviation from the true axis, a fact which, by the way, can be scientifically proven, is due to the great sunspots which recently sent more energy to the earth than at any other time during the thirty-five years sunspot period, and which, through the great differences in the corresponding temperatures, caused the formation of vast ice-masses at one or the other of the poles, of such weight that the distortion takes place, to be subsequently remedied by other variations.

As has been stated before in these columns, the consideration of a terrible calamity of this character immediately calls to the mind of the New Yorker the thought of what would happen should a similar disturbance occur in this region. From the experience to be gathered in the San Francisco earthquake and from what has been learned on other occasions, it would seem that many of New York's great modern buildings would stand a fair chance of immunity unless the convulsion were one of extraordinary violence, for not only is the great majority of the later structures of the riveted steel-frame type, but the underlying formation, particularly of the island of Manhattan, offers a solfd rock foundation of the most substantial nature. Little apprehension need be felt, however, for it is generally conceded by authorities on the subject that the city is not in any one of the various earthquake belts and that this vicinity is part of an area which, considered geologically, is past the formative period by many thousands of years.

METHOD FOR ELECTRO-DEPOSITION AND SEPARATION.

BY EDWARD C. BROADWELL.

There is an intermediate method between deposition from aqueous solutions and the high-temperature, chiefly endothermic, reactions rendered possible by the joulage of an arc or resistance electrical furnace.

A double borate or phosphate of barium or lithium and any metal the electro-positive nature of which does not exceed that of manganese furnishes a molten bath, from which the metal is easily deposited in pure carbon-free condition. Borates, phosphates, or silicates of the volatile alkaline metals, although giving good solvent baths, are useless if a perfectly smooth coating of the chem-energetic heavy earth metals is desired, as the greater part of the alkaline metal volatilizes, leaving the coating pitted.

While Mn, Cr, Mo, Ti, W, etc., produced by thermic reactions due to Winkler and perfected by Goldschmidt, can be had over 99 per cent purity, these metals are in infusible lumps, and only suitable for alloying.

In an endeavor to get metallic chromium in particular, as well as Mn, Mo, Ur, W, etc., in soft, pliable sheet form for tests as to their suitability (when shredded) for use as incandescent lamp filaments, I found, as claimed in several electro-chemical books and journals, that at even high E. M. F.'s these metals could be deposited only as pulverulent coats if at all; moreover, in either the arc or resistance furnaces, their carbides, which lack the qualification of infusibility at incandescent lamp temperatures, are always obtained, and for the purpose found useless.

In my initial experiments the ordinary blowpipe Pt wire loop was utilized as the retaining vessel and anode; the wire, being somewhat stouter than usually employed, was pushed through a clay pipestem, leaving enough of stem to seal in the glass rod as a handle, and around this pipestem, and curved so as to dip concentrically into the bead retained by the loop, was coiled a finer platinum wire, to act as the cathode, its tip being withdrawn from the bead and cut off and reimmersed in the bead as the work progressed.

My bead or electrolyte bath consisted of potassic fluoride, when the metals having a so-called higher solution pressure than manganese were to be deposited from the ore dissolved by the fused fluoride, and the borax or microsmic salt bead was found best for metals belonging to the iron, zinc, and heavy-metal groups. The oxide or roasted ore is picked up by the bead in the usual manner, and when the solution is complete and the bead clear, the fine curved Pt wire, previously connected to the negative pole of the generator, is then immersed and electrolysis begun. As practice, it is interesting to decolorize a blue cobalt bead, and if a milliamperemeter is handy, to estimate the amount of metal deposited. When two or more metals are in the bead or fusion, the metals, owing to non-interference of hydrogen, can be sharply separated by watching the inverse E. M. F. shown by the voltmeter when the external source of energy is cut out. In a potassic fluoride bead the complete and decisive separation of didymium into its nine more or less elements ought to be easily possible for the electro-chemist who is also master of the spectroscope; in fact, the separation into praseo and neo metal is within reach of the chemist who is not a physicist, as it is a matter of withdrawal of the old and substitution of a new cathode or wire tip the instant the potential difference across the bead or fusion suddenly jumps to a higher point, while the temperature is not varied.

With larger quantities of oxide under test, a platinum crucible is needful; and when a carbon rod is concentrically immersed, without touching the inside of same, into a bath of fluoride, borate, or phosphate as above mentioned, but made basic by a slight excess of baric or lithic carbonate, the metal will be deposited as a smooth bright coating upon the inside of the crucible when the carbon rod is put in electrical contact with the crucible by a stout wire, i. e., we have here primary pyro-electrolysis, I think for the first time intentionally, although Castner undoubtedly got this effect with his iron carbide particles in his wonderful improvement in sodium manufacture.

The dissolving or rather oxidizing carbon rod in the above case furnishes the E. M. F. and hence the electric energy. With chromic borate made basic with lithic carbonate, as high as 0.07 volt is shown by the carbon, even over and above the back or inverse E. M. F. due to the tendency of the deposit to redissolve in the bath. When an external source of energy is used, and a platinum plate taken for the anode in a borate or phosphate bath containing an excess of B_2O_3 or P_2O_5, should the P. D. across the crucible attain 30 volts or more, there is deposited with the metal the elements boron or phosphorus, thus giving the phosphids or borides and a loss of the crucible.

It is just possible chromium gun tubes and gas-engine cylinders are only a matter of the near future, and these articles cited as examples could only be manufactured by pyro-electric deposition, since a temperature of 5,400 deg. F. is required to fuse carbonless chromium, and an arc cannot be used or the metal will contain carbon, which even in small amounts greatly lowers the desired high fusion point, which allows of great resistance to erosion by intensely heated gases.

I have coated smooth tinplate sheet steel with a tough and beautifully uniform coat of pure chromium, which can be easily gotten from the steel by solution of the latter in alkaline bisulphites containing an excess of SO_2, and have hardened this stripped sheeting to chromic carbide by cementation for a couple of hours in hide charcoal, and find a material able to wear away carborundum as easily as a glass-hard file would a salmon brick.

For those who fractionate the photogenic oxides by the present tedious aqueous chemical methods, I am sure the above opens a new and valuable path, though it is evident metallurgy upon the large scale could hardly benefit by the above analytic methods.

THE BITE OF A GILA MONSTER.

In a recent issue of the SCIENTIFIC AMERICAN an article appeared written by D. Allen Willey describing and illustrating the Gila monster. The statement was made in the article that scientists had questioned whether its bite was fatally poisonous, as has been supposed. Mr. W. C. Barnes, of Las Vegas, N. M., claims to know of two cases, in one of which death resulted. Mr. Barnes writes as follows:

"The first man was in Tombstone, Ariz. The Gila was tied by the leg in a saloon as a curio, and a drunken gambler named Brown was teasing it. He carelessly stuck his first two fingers into its mouth, which immediately closed down on them, and could not be released until the reptile's head was cut off and the jaws cut apart. Brown suffered horrible agony for almost two days, and in spite of all efforts he died.

"The second case was in the fall of 1889. Walter Vail started from the 'Empire' ranch, near Benson, Ariz., to ride into town on horseback, some fifteen miles. A short distance from the ranch a monster was sluggishly dragging its way across the road. Thinking to take it in for a friend, he got down and killed it—or at least he thought he killed it. To carry it easily, he tied it on his saddle behind him, using his saddle strings for the purpose. As he loped along he thought to assure himself it hadn't dropped off by reaching around behind him with his right hand and feeling for the monster.

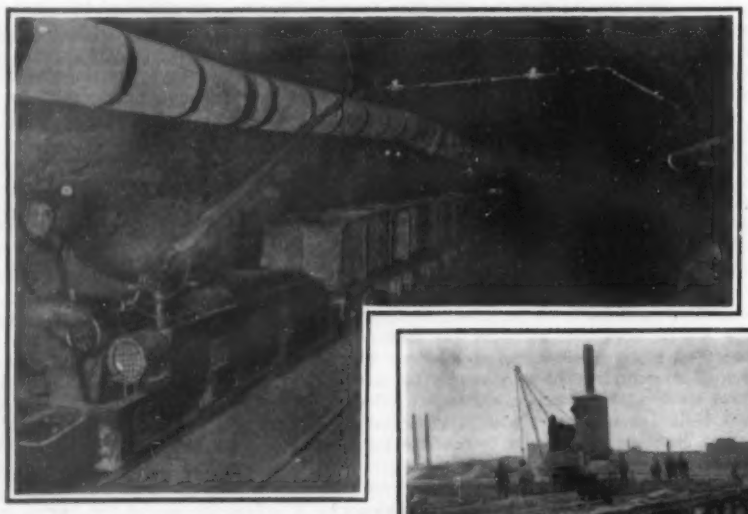
"It was there, and not nearly as dead as he thought. His first finger went into the reptile's mouth clear to the knuckle, and instantly those jaws with the long, sharp, dagger-like teeth closed on Vail's finger. With his left hand he managed to get his knife out and cut the saddle strings, and then had to dissect the head and jaws to get his finger from their grip.

"Vail then spurred his horse into Benson and found an engine in the yards. A hasty exchange of telegrams with the division superintendent and Tucson took place and in a few moments he was on the engine and racing over the road for Tucson, where an eminent surgeon resided at that time. Vail lay at death's door for two months and that finger to-day is useless and shriveled up from the effect of the bite."

At a mild red heat, good steel can be drawn out under the hammer to a fine point; at a bright red heat it will crumble under the hammer, and at a white heat it will fall to pieces.

THE CORTLANDT STREET TUNNELS AND TERMINAL BUILDING, NEW YORK.

It is probable that not many of the citizens of New York appreciate the magnitude of the system of tunnels beneath the Hudson River and under the streets of Manhattan and Jersey City, which the corporation, known as the Hudson Companies, is at present engaged in pushing through to an early completion. It is well known that four separate tube tunnels are being built through the silt below the Hudson River, but it is not so well understood that these tunnels are connected, both in Jersey City and in Manhattan, with the various transportation systems, subway, surface, and elevated, by means of extensions of the sub-river tunnels, which will parallel the Hudson River on both sides of it. The two northerly tunnels that have been completed extend under the Hudson from Fifteenth Street, Jersey City, to Morton Street, New York, whence they continue under Morton Street, Greenwich Street, and Christopher Street and up Sixth Avenue to a large terminal station at 33d Street. This branch will also have stations at 9th, 14th, 18th, 23d, and 28th Streets. At 9th Street and Sixth Avenue, a branch tunnel will be extended eastward under 9th Street to a connection with the Rapid Transit Subway below Astor Place.



Electric Locomotive Hauling Excavated Material in Hudson Companies' Tunnel Station, 85 Feet Below Present Pennsylvania Railroad Station.

Cut and Cover Work on the Section of Tunnel Connecting the Jersey City Terminal Stations.

THE CORTLANDT STREET TUNNELS.—The southerly pair of tunnels, known as the Cortlandt Street tunnels, are being built below the Hudson River from an underground station excavated beneath the present Pennsylvania Railroad Company's terminal station in Jersey City, to a large terminal station and building which is being constructed on a large block of ground in Manhattan bounded by Fulton Street on the north, Cortlandt Street on the south, and Church Street on the east. From the center of the Cortlandt Street terminal station, a subway will give access for passengers below Dey Street to the present Fulton Street station of the Rapid Transit Subway.

The Morton Street and Cortlandt Street tunnels will be connected on the Jersey side by twin tunnels, which will extend parallel with the Hudson River and below Washington Street from the Pennsylvania to the Lackawanna stations. Furthermore, there will be an extension of the Cortlandt Street tunnel in a westerly direction for about three-quarters of a mile, below the main line tracks of the Pennsylvania Railroad. From this tunnel the tracks will emerge to a connection with the main tracks of the Pennsylvania, over which the cars will be run to Newark.

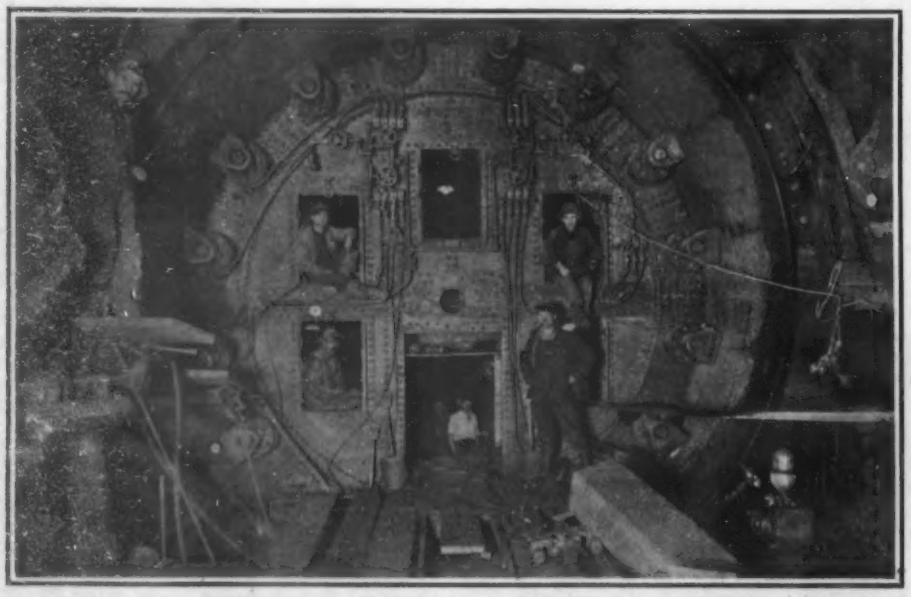
It will thus be seen that the Hudson Companies' tunnels have been laid out with the express purpose of placing the steam railroads which have their terminals in Jersey City in direct communication with the city of New York. Whichever of the Jersey City terminals a passenger may arrive at, by taking an elevator from within the station itself, he can descend to the platforms of the tunnel system, where he can take a train which will land him either at a terminal station in the heart of the downtown business district of Manhattan, or at one of several stations in the heart of the shopping district, while if he wishes to make connections with the New York Subway, he can do so at either the Fulton Street or Astor Place terminals.

JERSEY CITY DEEP LEVEL STATION.—It is seldom that an important engineering work of this magnitude is carried out as quietly as has been the work of excavating these tunnels and stations; indeed, there is one part of the work, the announcement of whose completion will come as a great surprise to the New York public. We refer to the construction of a large subterranean station, 85 feet below the present terminal station of the Pennsylvania Railroad in Jersey City. So quietly has this work been done, that although the company has cut out of the solid rock a station 150 feet in width, and with its approaches nearly a thousand feet in length, not a word as to the progress of this excavation has leaked out. The excavation is practically completed, and the task of concreting and finishing is well in hand. By reference to the accompanying map, it will be seen that the station provides for four, and in some places five, parallel tracks and the necessary platforms. Passengers coming in from Newark, or from the Lackawanna and Erie terminal stations, can either continue to Cortlandt Street, Manhattan, or by taking the elevators which run from the tunnel station up to the concourse of the Pennsylvania Railroad station above, they can take a train to points on the Pennsylvania system, or take one of the surface trolley cars. Similarly, passengers arriving by way of the Hudson tunnel from Cortlandt Street can either take the elevators to the station above, to connect with local or long-distance steam trains, or they can continue through the Washington Street tunnel to the other Jersey City terminal stations, or they can continue their journey without change of car to Newark, the first three-quarters of a mile of the trip to that city being made in the tunnel, and the rest of it over the Pennsylvania Railroad steam tracks.

The present state of the work is shown on the accompanying map by heavy black lines; and it will be seen that not only is the excavation completed for several blocks on Washington Street, and under the Pennsylvania Railroad station, but the tunnels have also been driven for about 3,500 feet underneath the Hudson River toward the Manhattan shore.

Special note should be made of the very rapid progress made with these two tunnels. They are being forced through the mud by simple displacement; that is to say, the mud is being crowded aside instead of being taken in through the vertical doors in the front of the shield, which was the method pursued in the earlier work on the Hudson River tunnels. In July of last year, the north tunnel was advanced and the massive rings put in and bolted up, for a distance of 962 feet, and the south tunnel for a distance of 678 feet, making a total of 1,640 feet of tube tunnel built in a single month. The greatest record for one day was made on August 13, when one of the tunnels was advanced 72 feet in 24 hours.

CORTLANDT STREET TERMINAL BUILDING.—The terminal at Cortlandt Street will be by far the largest office building in the world. It will contain twenty-two floors and four thousand offices. The site upon which it is being built extends for 400 feet on Church Street and 180 feet on Fulton and Cortlandt Streets. In order to find suitable foundations, it was necessary to go everywhere down to rock; and since the lower floors below ground level are also below water level, it was decided to inclose the whole of the area with a huge monolithic foundation wall of concrete 78 feet



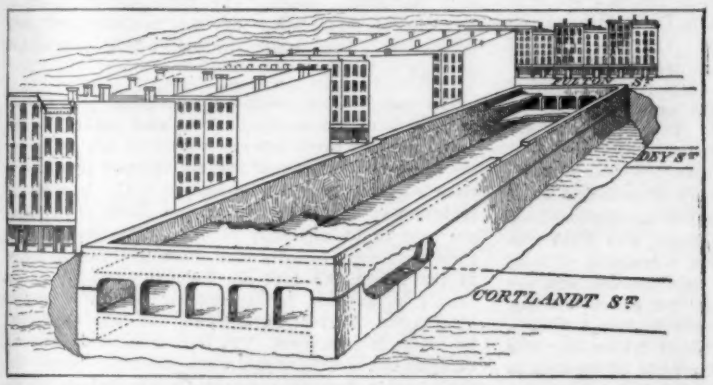
A Shield in Hudson Companies' Tunnel Excavation, Showing the Hydraulic Ram by Which It is Advanced and the Doors in Front Face by Which Excavated Material is Taken into Tunnel for Removal.

Shield at Work in the New York and Jersey South Tunnel Approach.

THE CORTLANDT STREET TUNNELS AND TERMINAL BUILDING, NEW YORK

in height and 8 feet in maximum thickness. The sinking of this foundation was a task of great magnitude, and it has been accomplished by means of rectangular caissons 8 feet in width by about 15 feet in length, which are sunk end to end, and entirely around the outside line of the building, down to bedrock. In order to key or dowel the adjoining blocks together, half-round forms are placed against the end walls of the caissons during the ramming of the concrete. These are subsequently withdrawn, the abutting sections of the caisson wall cut out, and the vertical circular hole thus formed is filled up with concrete tightly rammed in place. This not only keys the abutting sections of the walls together, but seryes also to seal them against the inflow of water. That portion of the building contained within this wall, and lying below street level, will have three floors, the first below the street being the concourse floor, the second the station floor for the tunnel trains, and the lowest containing the power plant. Above the street level the building will be carried up as two separate structures, one on each side of Dey Street, built in the style of the Italian Renaissance. Up to the fourth story the building will be finished in polished granite and Indiana limestone; above that it will be of brick and terra cotta. An idea of the size of the building may be obtained by comparing it with the Broad Exchange building, at present the largest office building in Manhattan, which contains seven million cubic feet of space. It would take nearly three Broad Exchange buildings to fill the space occupied by the Cortlandt Street Terminal building, and in the four thousand offices will be accommodation for at least twenty-five thousand persons. This great population will be handled by thirty-nine elevators, which between them will probably handle some thirty to forty thousand people daily.

One of the Caisson Forms Used in Building and Sinking the Huge Concrete Wall, 8 Feet Thick and 75 Feet Deep, Inclosing the Foundations of the Cortlandt Street Terminal Station.

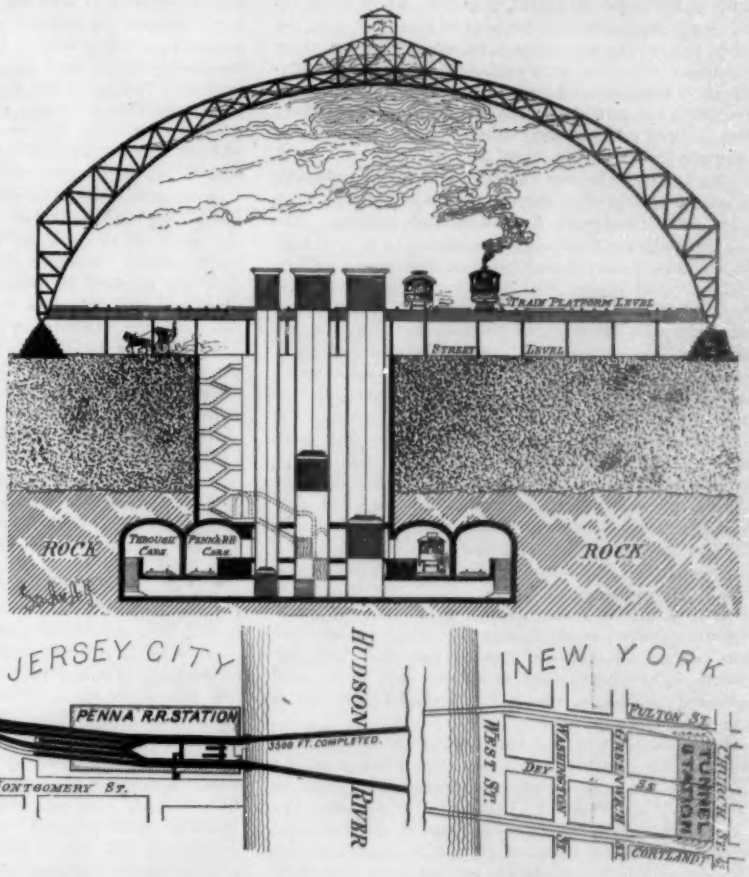


View of the Huge Concrete Foundation of the Cortlandt Street Terminal Station of the Hudson Companies Tunnels. It Forms Practically an Unbroken Rectangular Box 8 Feet Thick, 75 Feet Deep, 180 Feet Wide and 420 Feet Long. The End Walls Will be Pierced to Admit the Five Tunnel Tracks.

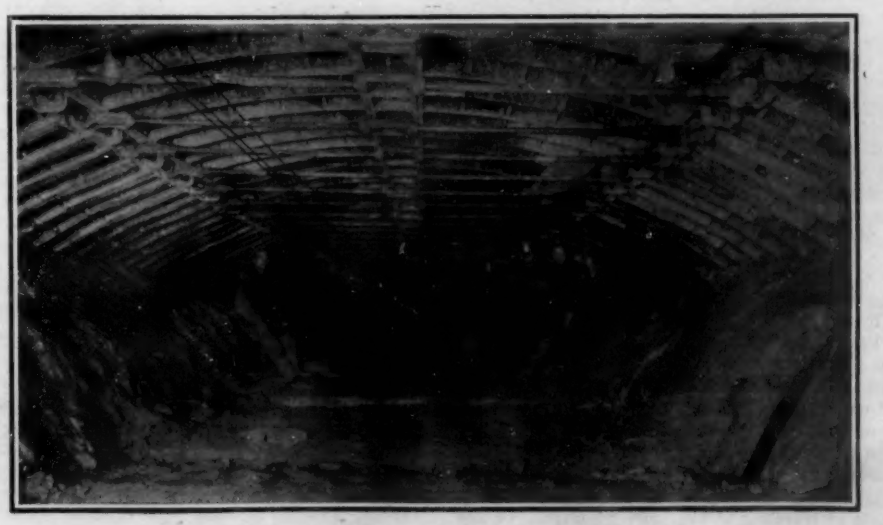
THE TERMINAL STATION.—The trains arriving from New Jersey will enter the station on five parallel tracks, which will extend entirely across the length of the building, and will be served by six platforms. There will be absolutely no switching. The trains, which will consist during the rush hours of eight cars each, the cars being provided with both center and end doors for rapid loading and unloading, will discharge their passengers upon the platform on one side, and receive their passengers from the platform on the opposite side—an arrangement which entirely separates incoming and outgoing passengers, both on the platforms and on the cars, and conduces to great rapidity of handling.

Passengers will enter the building upon the street floor and pass to the concourse on the floor below by stairways, inclined planes, and elevators. Here will be the waiting rooms, telegraph and telephone rooms, restaurants, and other conveniences of a large railway station. Access will be had from the concourse to the station floor by stairways and elevators. The cars, which will be built of steel, will be large enough to accommodate fifty persons. During the rush hours, it is proposed to operate eight-car trains on a headway of one and one-half minutes between trains; and as the passage under the river will probably average only three or four minutes, a resident of Jersey City should be able to reach the shopping district or downtown district in from six to ten minutes after leaving the Jersey side.

In conclusion, we may mention that as soon as the new Pennsylvania Railroad station at 33d Street has been completed, the big terminal station in Jersey City will be abandoned for steam trains and turned over for the use of the Hudson Companies, who anticipate such an increase in traffic that they will need all the tracks in both the tunnel and surface stations to accommodate the trains.



Plan and Section, Showing the Large Tunnel Station, 85 Feet Below the Pennsylvania Station, Jersey City, and Its Connection, by Tunnels Below the Hudson, with the Cortlandt Street Terminal, New York. The Heavy Black Lines Show, in the Plan, the Extent of the Completed Work.



Building the Roof of the Hudson Street Station.

THE CORTLANDT STREET TUNNELS AND TERMINAL BUILDING, NEW YORK.

A Sparklet Inflator.

A handy device which should possess many attractive features to automobilists has recently been introduced to the English market by the inventors of the Parsons non-skid device for wheels. It is called a sparklet inflator, and consists of a small cylinder charged with CO_2 gas, such as is used for the aeration of mineral waters. It has been found that this gas exercises no deleterious effect upon the rubber used for the manufacture of the inner tube, and owing to the fact that oxygen is absent, it is stated to be more suitable for inflation than air. The cylinder is fitted with a gage, valve, and short length of rubber tubing for connecting it with the valve of the tire. All that is necessary is to attach the connecting pipe to the inner-tube valve piece, and open the valve controlling the passage of the gas from the cylinder, the gas issuing in a steady stream at a uniform pressure, as may be observed by reading the gage. Directly the tire is fully inflated, the gas supply is cut off by closing the valve, and the tube replaced. One great advantage in handling cylinders charged with this gas is that no danger is incurred. In the remote event of a cylinder breaking no explosion would result, but the liquid gas would rapidly evaporate in the form of a mist. Each cylinder, though only about 16 inches in length by 2 inches in diameter, contains when fully charged sufficient gas for the full inflation of a tire 34.3 by 3.55 inches ten times, and the empty cylinders can be easily and cheaply recharged. As a labor-saving device these cylinders possess many advantages. A tire can not only be inflated expeditiously, but without that physical effort required in accomplishing the operation with a

foot pump, which in the case of a large tire which has to be inflated to a pressure of 90 pounds or more is an exhausting and tedious task. The convenience of these gas inflators was strikingly demonstrated on the occasion of the last Herkomer trophy trials, when the competing Daimler cars were all equipped with this device, and the saving in labor and time which their utilization effected was appreciated by the respective competitors.

The Seventh National Automobile Show.

Last week, for the second time, the Licensed Association of Automobile Manufacturers held its show in Madison Square Garden. Some idea of the features of the new cars exhibited was given in a forecast of this show in our Automobile Number. A brief summary of improvements noted is given herewith.

Thirty-six different firms exhibited some 176 different gasoline pleasure cars. All but one of these firms showed a 4-cylinder car; six of them also exhibited a 6-cylinder car; one a car with an 8-cylinder, V-type motor; one a 3-cylinder, 2-cycle car, besides a car fitted with a 4-cylinder, 2-cycle engine as well; three, double-opposed cylinder cars, and one a light car with a 2-cylinder air-cooled V motor; while three exhibited a single-cylinder car, one of these being of the very light, air-cooled type. Practically all of these machines were fitted with engines having mechanically-operated inlet valves in place of the old-style, suction-operated, automatic type. A majority of the engines had jump-spark ignition either from a high-tension magneto or from the usual accumulators and coils. A small percentage was equipped with make-and-break ignition supplied with current from a low-tension magneto, and several were fitted with both systems. The use of mechanical lubricators appeared to be well-nigh universal. Imported ball bearings are employed lavishly on most of the large, high-priced cars; but roller bearings also find favor with many of the makers, one of whom calls attention to the fact that from the motor to the rear wheels the power is transmitted solely on and by rollers. The special form of roller bevel drive which makes this statement possible, will be found illustrated in our Automobile Number. The sliding gear transmission is almost universally used, also, the only exceptions being some of the single, double-opposed, and 8-cylinder cars (which were fitted with a 2-speed planetary gear), and the light one-cylinder and two-cylinder V-motor cars, which had a friction-disk device. A large 4-cylinder limousine with a dynamo and electric motor in line with the crank-shaft and arranged so as to form a magnetic clutch, contained the only real novelty in the way of transmissions. For novel mechanical transmissions, one has to revert to the Automobile Club show held last month in the Grand Central Palace. The most novel of these transmission gears will be found described in our Automobile Number.

Other mechanical features noted on the new models, such as the driving of fans and lubricators positively by gears, we have already commented upon. On one high-grade car that still uses a belt-driven fan, two round leather belts are used in place of the single flat belt employed by some of the other manufacturers. No automatic motor-starting apparatus—a feature of the recent Paris Salon—was shown; but this is an improvement that will come in time and that has been produced more quickly abroad on account of the offering of several special prizes. Small cylinders of compressed carbonic acid gas—at a pressure of 1,000 lbs. per square inch—are now to be had at a reasonable figure. These are used for inflating tires and are fitted with a special reducing valve and gage by means of which any pressure up to 300 pounds can be had and indicated. About twenty tires can be inflated per cylinder. Compressed acetylene is also carried on most of the large cars. A recent improved system of compressing and absorbing this gas makes it possible to carry sufficient in a cylinder of medium size to supply one ½-foot burner for 100 hours. Electric headlights and searchlights fed by current from a dynamo run by the engine are still one of the developments of the future. One firm which builds a small dynamo for keeping the ignition cells constantly charged has worked out this idea on a small scale, and doubtless in another year we shall see its commercial application. A brilliant, never-failing light at night should always be instantly available when the car will run.

The display of electric vehicles this year was large and interesting, there being no less than 29 pleasure vehicles of this type exhibited in the concert hall. No less than 17 of these were runabouts, having a radius of from 50 to 75 miles on a charge, and capable of speeds up to 20 and even 30 miles an hour. The most distinctive of these was modeled on the lines of the popular 4-cylinder gasoline runabout with rumble seat, the battery of 32 cells being placed forward under the bonnet. Fitted with a 3½-horse-power motor hung forward of the rear axle, and driving it through bevel gears, this car is said to be capable of traveling at a speed of 30 miles an hour for 1½ hours, or of making from 75 to 80 miles at a speed of 15 miles an hour. It is fitted with six speeds forward and three speeds backward.

Another novelty in electric machines is the use of pressed steel frames and double internal and external expanding brakes on the rear wheels, in addition to an electric brake. A well-known manufacturer showed machines with interchangeable bodies. By removing six bolts the Stanhope body can be readily taken off and replaced by a closed coupé body for winter use. Still another variation of this idea makes it possible to transform an open rig into a closed coupé by setting the closed body upon the open one. Chain and gear drive appear to be about equally distributed among the electric vehicles. Where the former is used, it is sometimes of the single and sometimes of the double side-chain type. The necessary speed reduction from the motor to the countershaft is obtained generally by a special form of wide, silent chain.

Besides the runabouts and other light electric machines, a considerable number of heavy, closed vehicles were shown. These, as a rule, are fitted with about forty cells of storage battery, thus making them capable of being readily recharged from the usual lighting circuits. Some makers, however, still cling to a reduced number of cells, though the general tendency seems to be to increase the number, even in the lighter rigs, to as many as twenty-four or thirty. The pasted form of storage battery is used almost entirely in the pleasure vehicles. The grids are made heavier in one type of these cells, thereby giving them a longer life although slightly increasing the weight. The Edison battery was not on exhibition in the present show, nor was it seen in any of the electric vehicles.

So numerous were the exhibitors of parts and accessories, that every nook and cranny of the Garden, from the basement to the third tier boxes, was filled with small exhibits. Some of the most noteworthy of these were the displays of different steel makers, who are producing special grades of steel for automobile use. One company exhibited a crankshaft forged from a solid billet by bending and without taking any cuts out of the steel. In this way the grain of the steel is preserved, and a much stronger crankshaft is produced. A test of a small steel rod about a foot long and half an inch in diameter, by weighting the rod at each end with 150 pounds, thus springing it out of line at the center 7-16 of an inch, and then revolving it rapidly with an electric motor, was most interesting. The total number of revolutions was recorded by speed counters, and these were found to run up to nearly a million before the steel would break. Another firm exhibited a four-speed transmission, having double bevel gears for direct drive on two of the speeds, and which was said to have run 36,000 miles in a 4-cylinder car. The gears were in a remarkable state of preservation considering the distance they had driven the machine.

A number of quickly detachable rims of ingenious design and a self-healing inner tube formed the chief novelties in the tire line. One of the best quickly-detachable rims consisted of a ring with a groove into which a locking ring was expanded as soon as the tire-retaining ring was slipped into place. No tools whatever were required to operate this device. The self-healing tube had a central layer of silk waste and some gummy substance, which immediately closed up the hole if the tire was punctured. A considerable number of non-skidding tires and protective bands were also shown.

About a dozen different types of speedometers were on exhibition. Most of these were devised to operate by centrifugal force, and all of them required a flexible shaft from the wheel to the instrument when an odometer was combined with the speedometer. A new form of electric speedometer consisting of a voltmeter placed on the dash, and operated by current from a small magneto placed at the wheel, was the only one which did not require a flexible shaft, although it will be recalled there are several makes of air instrument in which merely flexible tubing is necessary if the speedometer is used alone. A new form of imported instrument, besides the usual speedometer and total and trip odometer, had a clock combined in the same casing.

A compressed-air brake applicable to any automobile was another novelty in the accessory line, while the use of compressed air for this purpose, and also for operating the clutch, was shown applied in a very thorough manner in a 60-horse-power touring car of a well-known make. This machine is a distinctively American production, and has incorporated in it ideas which will no doubt be copied by some of the foreign makers.

The exhibit of commercial vehicles in the basement was not a particularly large one, its most striking feature being the use of the electric truck. Machines of this type have been adapted to a large number of purposes, and have been found to give a considerable degree of satisfaction for city work. When it comes to hauling large loads for long distances, gasoline trucks must necessarily be used. The combination gasoline-electric truck has not yet made its appearance. Such a vehicle would seem to offer many advantages

Science Notes.

At a recent meeting of the French Academy of Sciences, Prof. Delage read an account of a series of experiments made by M. Marage on the sense of hearing in fishes. Many difficulties were encountered in performing accurate experiments. If a fish be placed in a tank, the sound being reflected from all the walls, the animal having no clew as to the origin of the sound vibrations, will make no attempt at fleeing. If, however, the fishes are experimented on in the state of liberty, these investigations will be found still more difficult. At all events, fishermen do believe in the sense of hearing of fishes. Marage used an India-rubber funnel to transmit the sound to the water, this funnel being tuned to the number of vibrations of the sound in question. The vowels a, e, i, o, u, were produced within a range of four octaves, and with the energy generally used with deaf-mutes. The experiments were made on fishes, both at liberty and in captivity. In the latter case, a diver was able to perceive and to analyze the sound vibrations in the water to distances up to 100 feet. Although these vibrations failed to show any effect on the fishes, M. Marage thinks it quite possible that the animals may hear the noises produced by fishermen. It should, however, be remembered that this rudimentary sense of hearing is compensated by highly-developed senses of touch and vision.

The fact that a luminous emanation of variable shape will appear in the dark at such points on the surface of the earth below which there are extensive ore deposits at a more or less considerable depth, was recorded in Germany as far back as 1747. Immediately before or during a thunderstorm these phenomena are said to be especially striking. Similar observations have more recently been made in North America in the neighborhood of ore deposits. Though much should be ascribed to superstition and to errors of observation, the fact nevertheless has been confirmed by recent investigation. The electric emanation given off from the surface of the earth (see Prometheus, No. 891) has in fact been repeatedly ascertained photographically by Mr. K. Zenger. Plates coated with fluorescent substances were used. It may thus be taken for granted that the emanations in question occur with an especially high intensity at those points of the ground where good conductors of electricity are found in large amounts in the neighborhood of the surface of the earth, in other words, above ore deposits, which are very good conductors of the electric current. Lignite and coal, especially when containing pyrites, are fairly good conductors. The difference in the intensity of radiation as compared with points free from any ore would seem to be recognized by means of photography, thus affording to geologists a rather simple means of locating ore and even coal deposits.

A force now almost universally recognized as important, but ridiculed a few years ago, is the correspondence schools. These schools betake themselves to the student wherever he may be and lay before him knowledge that he should possess. While it is true that much, if not most, of the information given him could be purchased at a price much less than he pays the correspondence school, still the student is not familiar with technical literature and would not know what to buy. The correspondence schools make the selection and the student pays the bill. When all is said, however, about the superiority of the living teacher over the printed page, it still remains true that there are "many of us" and that it is impossible to open too many avenues for those who desire instruction. There should be no aristocracy of learning. Let each one get all he can in the way easiest for him and let no one fortunate enough to secure a high grade engineering education begrudge the lone engine-man far removed from books, schools, or persons of education, the little he may glean from his correspondence papers. William E. Curtis, the celebrated correspondent of the Chicago Record-Herald, never thought he was conducting the greatest correspondence school in the world, nor did his vast number of readers ever realize that they were taking a corresponding course, until the advent of the correspondence school. Yet the fundamental ideas in both lines of work are identical. The idea of the correspondence school is the one fact in educational annals of the past twenty years that stands out prominently because of its pure bigness. Probably not less than two million people in the United States have taken one or more courses in some correspondence school.

There are many massaging devices which call for the use of the electrical current, so that their employment is restricted to homes and establishments where the electricity is available. A new apparatus recently placed on the market is driven by a water motor attached to the spigot. The head of water secured from an ordinary water supply is entirely sufficient for this purpose, and the apparatus is a handy combination as well as an economical one.

Correspondence.

The Gun Erosion Problem.

To the Editor of the SCIENTIFIC AMERICAN:

May an outsider ask a question about this gun erosion problem?

Assuming that it takes less heat to soften some one ingredient of the steel that it does the others, also that small particles of this softer substance are exposed to the intense heat of the burning powder, would this condition of things offer a weak spot for heat and friction (one or both) to break down the surface of the bore?

Or, is it possible that there is some chemical affinity between one or more of the ingredients of the steel and one or more of the ingredients of the powder, that in the presence of the intense heat decomposes the surface of the bore?

The laws of chemistry and physics have come to be so well understood, surely this problem would be solved if put into the hands of men who understood these sciences. WILLIAM R. LEE, M.D.

[It is believed that the erosion may be partly due to chemical action; although the greater part of the destruction is generally thought to be due to the fusion and carrying away of the metal surface by the great heat of the swiftly-moving gases, the irregularity of the erosion being due both to the composition of the steel and the successive local action of the gases.—EDITOR.]

The Origin of the Word "Scientific."

To the Editor of the SCIENTIFIC AMERICAN:

Could you tell me the origin of the word "scientific," which shines in the name of your very excellent periodical? I have succeeded in tracing it back to the middle of the thirteenth century, when the famous Robert Grosseteste, Bishop of Lincoln, uses the word *scientificus* in a passage that might serve for your motto.

Robert of Lincoln used the term *scientificus* in or about 1246 in a letter to Henry III., King of England, The passage appears in the letters of Robert, well edited by H. R. Luard, 1861, in the Rolls series, page 350.

The King had asked why the rite of anointing was used at the public coronation of kings. The great bishop answered that he was no authority in secular state matters, but suggested that kings might be properly anointed at the coronation as members of the church are at the confirmation, when they receive episcopal benediction and the sevenfold spirit of wisdom, understanding, *counsel*, might, knowledge, etc., as stated in Isaiah xi, 2. The Latin text calls it the "spiritus domini, sapientiae, intellectus, *consilii*, fortitudinis, scientiae, pietatis."

The great bishop offers a brief interpretation, and says: "Ad praedicta autem praecellenter agenda dono consilii decoretur (sc. rex), quo artificialiter et scientifice ordo hujus mundi sensibilis edocetur;" or in English, "to do well what is required of him, the king needs the gift of counsel, which teaches the proper order of this world in the spirit of true art and science."

Assuming that Robert used a new word—for he answered a new question—he did not act without some precedent. In saying *artificialiter*, he meant "filled with the spirit of the seven arts, grammar, rhetoric, logic, arithmetic, music, geometry, astronomy. He adds that a true king should be taught *scientifice*, which means in the spirit of science, or filled with the genius of science. Robert might well use the term, as he was justly called the first man of science in his day by Roger Bacon, himself a great man of science. The immediate precedent for *scientifice* was the common use of similar terms in Scotus Erigena, whom Robert studied with care. Scotus Erigena, also a British author, has *sapientificus*, *potentificus*, *multificus*, etc., where the termination *ficus* means replete with. The earlier *pacificus* does not mean making peace, but filled with peace.

The early divines frequently call the Bible *deificus*, meaning filled with the divine spirit, not making God. In the classics *magnificus* means filled with greatness. *Scientificus*, in Robert of Lincoln, means filled with the spirit of science. He wishes his king to have the genius and spirit of the arts and sciences, not the technicalities of the school or the professor.

The medieval church often called for scientific men, meaning men amply trained in liberal learning.

You have honored the name "American," and your distinctive "Scientific" has a beautiful history and meaning. If Robert of Lincoln be the father of the term, no better could be desired; neither could a better age, for in 1246 England was happier, perhaps, than ever before or since; it was the age of cathedral building, of great learning inspired by Greek, the crusades, the rise of universities, the study of nature, and a galaxy of eminent men. The people were happy. Robert of Lincoln, Roger Bacon, Bracton, are studied to-day.

I congratulate you, and submit these notes as a starter for scholarship to enlarge and improve.

Swampscott, Mass. C. W. ERNST.

Some More "Man in the Drift."

To the Editor of the SCIENTIFIC AMERICAN:

I ask to be indulged in submitting the following statements, as evidence of man in the drift; and hope they will prove of sufficient note to call forth expressions of judgment from those who are authority on such subjects, and especially on this class of evidence. Were the writer, after speculating many years, able to see one single weak point in the argument contained in these data, they would not have been here presented. The relics in evidence, a physical description of three of which I here present, consist of ovate spheroids (egg-shaped), slightly flattened, as shown in transverse diameters, of syenitic or hornblendic granite, so far as observed. The following table of dimensions is its own argument, as to the origin of the relics under consideration, as to whether they are the products of accident or design.

	Lines. No. 1.	Lines. No. 2.	Lines. No. 3.
Major axial circumference.....	483	320	309
Minor axial circumference.....	460	306	297
Major transverse circumference...	362	249	230
Axial diameter (major axis).....	177	117	114
Transverse diameter (superior)...	126	84	78
Transverse diameter (inferior)...	108	72	66

No. 1 was taken from a drift moraine gravel bank two miles north of Massillon, Ohio, by an employe of the Cleveland, Lorain & Wheeling Railway.

Nos. 2 and 3 the writer obtained from a deep excavation for a street, on Deuber Heights, in the city of Canton, Ohio. Am positive they were taken from a depth of 10 feet or more, as they were found on top of dump after cut was 18 or 20 feet deep, and as further evidenced, the surface of No. 3 was, and still is, covered with a calcareous incrustation, which could not have occurred had it lain near the surface.

The figures showing the relative dimensions of these specimens, to me, display a marvelous and yet unwavering set of facts. I have examined gravel, and boulder deposits by the acre, by the thousands of tons, and by the week, in the glacial gravel deposits of Stark, Tuscarawas, Columbiana, and other Ohio counties; lacustrine gravels on Lake Erie and other beaches; fluvatile gravels on the beds of many rivers; and yet have never discovered a single one among the inestimable millions that the accidents of natural forces had formed in such perfect symmetry, and that, too, a type of a once vital organism. Bowlders of any form, the sizes of the subjects of this paper, are very rare in the drift. If practically all drift moraine bowlders of such sizes and materials are of the form and proportions of these types presented, why, if the work of accident, are not the smaller bowlders and gravels, which have been subject to the same mechanical manipulations, and other environmental processes, reduced to the same forms, and in the same generous proportions? There were two other specimens of like form and dimensions in the shanty of a tender of a gravel bank, at South Massillon (which were not measured), thus making an aggregate of five, strictly of one type in all essentials, found within a distance of nine miles. On the other hand, the small bowlders and gravels never present you with a single type of perfect outlines, or duplicates of any vital organism, though they are millions to the others' one. Why not? E. V. MORSE.

Burton, O., October 28, 1906.

How the Ocean Got Its Saltness.

To the Editor of the SCIENTIFIC AMERICAN:

In Notes and Queries No. 10186, October 27, 1906, J. C. B. asks: "From what source does the ocean derive its intense saltiness, and how retain the same in uniform strength?" Your answer: "The salt now in the ocean has been in the past ages washed out of the land or dissolved from beds of salt in the earth to which the water gained access. The original water was fresh. It became salt by dissolving salt from the earth."

It seems to me your answer is not in accord with the teachings of geology. You do not explain how beds of salt were formed in the earth. Salt is not one of the elements, but a compound of chlorine and sodium, and these elements had to be in solution in water to enable them to get together. Prof. Alex. Winchell in his "Sketches of Creation," pages 294 to 306, explains how salt was formed in the earth and in the ocean, claiming that all salt beds are dried up remnants of the ocean. The great stratum of rock salt that lies more than 1,000 feet below the surface under southern Michigan and Canada, but is mined in Cayuga and Onondaga counties, New York, is a remnant of a dried-up gulf of the ocean that existed in the Silurian period, and extended from Milwaukee eastward beyond Syracuse, and from Mackinac on the north to Sandusky on the south. All other beds of salt were similar dried-up portions of the ocean. On page 296 he says: "How the waters of the sea came into possession of their saltiness is a question of primeval chemistry to which allusion has heretofore been made (pages 49 to 63). It was the resultant of the chemical actions which took place between the fire-born rocks and the chemical acids washed down by the primeval rains, and gathered with the 'gathering together of the waters.'"

On pages 49 to 63 he relates that at some stage of development all the heavier elements, as silicon, aluminium, iron, calcium, potassium, sodium, etc., constituted a molten globe, which was surrounded by the lighter elements, hydrogen, oxygen, carbon, sulphur, chlorine, etc., in a gaseous state. When the conditions became sufficiently cool oxygen and hydrogen united and formed water, which fell as rain on the central globe, bringing down with it the carbon, sulphur, chlorine, etc., in the form of acids, which united with the various mineral elements, producing gypsum, Glauber and Epsom salts, etc. Carbonic acid united with calcium and produced lime. And now to quote, page 60: "Carbonate of lime refusing, for the greater part, to be dissolved in the sea water, would settle to the bottom and become limestone; while chloride of sodium—chlorine and sodium united, which is only the chemist's name for common salt—remained in solution, and this gave its characteristic salinity to the sea."

So this is when and how the ocean got its saltness, as defined by Prof. Alex. Winchell, who is quoted by other geologists as authority on this subject. Its water was salty as soon as it became the ocean and chemical unions took place; it was never fresh water only while falling as primeval rain. C. W. BENNETT.

Coldwater, Mich.

Prevention of Railroad Accidents.

To the Editor of the SCIENTIFIC AMERICAN:

In view of the recent terrible calamities on the railroads, I am led to inquire if there is not some possible preventive not yet utilized; and in this line I wish to suggest one for your consideration.

Suppose every important switch were guarded by two responsible men instead of one—each one of these to be held responsible, as if he were the only one in charge—would it not reduce the chances of mistakes to a minimum? The banks employ two separate and independent clocks on their time locks, on the ground that they are not likely to both fail at the same time; and why should the lives of two whole trainloads of passengers be dependent upon the faithfulness or competency or vigilance of a single individual, when experience shows that the best men do sometimes make mistakes? And in like manner the occupants of other important positions might be duplicated, so that any single oversight by one might be detected by his associate in time to avoid disaster. Under such conditions no mistakes would be likely to occur without a most culpable neglect of duty, in which case a much more severe penalty might reasonably be affixed, which would tend to secure the safety of passengers in a marked degree. EBEN BROWN.

Boston, Mass., January 4, 1907.

The Current Supplement.

The current SUPPLEMENT, No. 1621, contains a most unusual variety of instructive scientific matter. The first of all is the opening article by the English correspondent of the SCIENTIFIC AMERICAN upon the combined ice-breaking, salvage, and survey steamer recently completed for the Canadian government. Next follows an illuminating exposition by F. W. McNair of some problems connected with deep mining in the Lake Superior copper district. Readers of the SCIENTIFIC AMERICAN will doubtless recall the gyrostatic device invented by Otto Schlick, the well-known German marine engineer, and described some time ago in these columns. Mr. Schlick's device was intended to prevent the rolling and pitching of ships at sea. Since the publication of that article the gyrostat has been practically tested on a German vessel, and in the current SUPPLEMENT Mr. Schlick himself gives the results of that experiment. The first installment of an important treatise on the new electric lamps appears. In this series of articles the new metallic filament lamps will be thoroughly discussed. L. Ramakers writes on the great wireless telegraph station at Nauen, Germany, of which we have been hearing much of late. Mr. A. E. Potter contributes a well-considered article on variations in horse-power developed by automobile gas engines. The excavations which have recently been made on the site of the ancient Chaldean city of Sirpourla throw much light upon ancient art. The Paris correspondent of the SCIENTIFIC AMERICAN contributes an illustrated article on these excavations. Miss Rose O'Halloran, whose solar research work is known to every astronomer, writes on the decline of the sun-spot maximum. To the layman it would not appear to be difficult to prove the existence or non-existence of the relation between intelligence and brain weight, but the difficulty of the problem is told in an instructive article published in the current SUPPLEMENT.

THE WORK OF THE ROTARY SNOW PLOW.

BY WALDON FAWCETT.

On the American railway lines which are called upon during the winter to combat the heaviest drifts of snow, the form of plow known technically as the rotary is rapidly superseding all other forms of apparatus for clearing paths for trains. It is this interesting adjunct of the equipment of the up-to-date steam road that has rendered possible the maintenance of communication in the face of blizzards on lines that traverse the higher levels of the Rocky Mountains—steel-tracked highways that in some instances attain an altitude of 11,000 to 12,000 feet above sea level.

The rotary, in the present scope of its operations, is a comparatively recent innovation. The transcontinental railroads were largely dependent in the early days upon the hand shovel as a means for clearing the tracks, and it was frequently necessary to detail all available employees of the road for this labor in order to keep the trains moving. In some instances locomotives in strings of three, four, or more, forming improvised battering rams, were employed to aid the hand-shovelers, but the danger of derailment was so great that the practice had to be abandoned except under especially favorable circumstances.

However, this rather primitive method of employing the locomotive as a snow fighter pointed the way for the invention of the push plow or "gouger," which might be termed the immediate predecessor of the present-day rotary. Indeed, the wedge-shaped plow which "bucks" the drifts, impelled by the force of several locomotives behind it, is a type which yet finds extensive utilization on railroads which are seldom called upon to cope with a heavy snow blockade.

The rotary, which has revolutionized the method of battling with an excess of snow, is, in its principle of operation, radically dissimilar to the earlier design of snow plow in that, instead of scooping or shoveling aside the snow by mere force of impact, it virtually burrows or bores its way through the barriers presented. This is accomplished by means of a large wheel or snow screw located at the forward end of the machine. This wheel, which somewhat resembles in form the propeller of a steamship, is, in the case of the average plow, from eight to twelve feet in diameter, although this latter dimension is exceeded in the case of the largest rotary in the world, which is a feature of the rolling stock of the Denver, Northwestern & Pacific Railway—the Moffat road in Colorado.

The snow screw of a rotary is made up of a series of hollow, cone-shaped steel scoops, each equipped with a knife. As the wheel revolves at high speed, these blades strike the snow and ice, loosening it and throwing it into the scoops. The wheel proper is inclosed in a metal hood, at the top of which is a square opening or funnel. By the revolution of the wheel the snow caught up by the scoops is thrown through this opening with great force, and the funnel is so shaped that the snow is hurled in an oblique direction, and caused to fall at a distance of from fifty to one hundred feet from the side of the track, according to the speed at which the wheel is being operated. Moreover, the hood is given an inclination so that the falling snow does not descend upon the top of the rotary, and bury the machine in a drift of its own making.

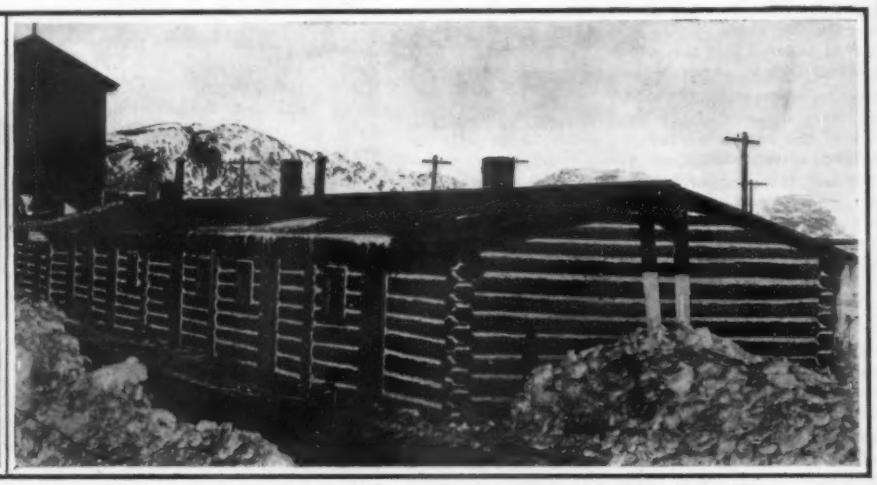
Locomotives are, of course, required for the propulsion of the rotary, but the snow screw is actuated by an independent engine of a design somewhat in accord with the familiar marine type. The rotary must withstand the force of the pushing engines behind as well as counteract the side motion of the large wheel, and consequently the roof and sides of the machine as well as the framework are of iron and steel construction, and the machinery is set as near to the ground as possible, in order to contribute to its stability. The weight of the average rotary, complete with tender for fuel and water, considerably exceeds one hundred tons.

A rotary traversing a snow-blocked track is operated at a speed varying from two to twelve miles per hour, according to the character of the drifts encountered. The plow can burrow through light or soft snow at the last-mentioned speed, but when densely-packed banks are encountered, which have ice formations four or five inches in thickness scattered through the snow, it is seldom considered safe to attempt to operate at a speed exceeding four miles per hour. The weight and character of the snow also dictates the speed at which the snow screw is operated, the latitude allowed being that between one hundred and fifty and three hundred revolutions per minute.

A pilot stationed in a pilot house at the forward end of the rotary directs all the operations of the plow, not only regulating the speed of the snow screw in accordance with the fluctuations recorded by a resistance indicator, but also communicating to the engineers of the locomotives in the rear the necessary instructions regarding the increase or diminution of speed as circumstances may necessitate. It is claimed that a rotary plow could be successfully operated, on the auger principle, in snow of any depth, if means be found to get rid of the snow excavated.

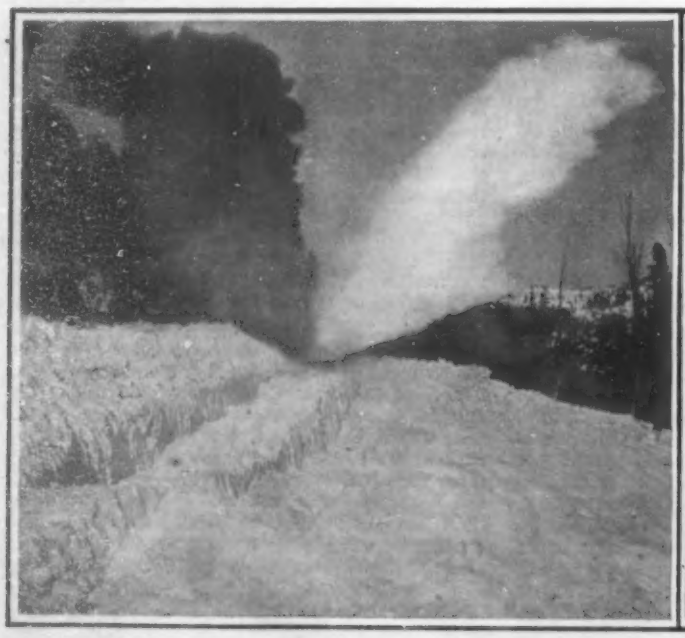
Aside from its increased efficiency, the rotary has recommended itself to railroad officials by reason of the economy of its operation as compared with the "gouger" type of plow. A rotary never requires more than two locomotives to push it through the heaviest drifts, whereas it was nothing uncommon, when the wedge-shaped plows were almost universally employed on the Rocky Mountain divisions of the railroads, to see seven locomotives employed to furnish the requisite energy to shove one of the old-fashioned plows through heavy drifts. At certain seasons of the year almost every passenger train on the mountain roads is preceded by a rotary. This is necessary by reason of the fact that in exposed locations a strong cross wind will, in as short an interval as fifteen minutes, pile up a formidable drift in a location that has been cleared by a rotary. In the region that might be termed the home of the rotary, it is nothing unusual for an aggregate snowfall of more than 42 feet to be recorded during the season.

At the Rear of a Rotary Snow Plow Pulling Up a Mountain Side.



The Strongest Wooden Railway Station in America, Situated at Corona, Col., in the Rocky Mountains at an Altitude of 11,660 feet.

The results have been published of tests of automatic couplers submitted to a commission of Russian railroads in response to an offer of prizes in an international competition for the best automatic coupling. Not a single coupler has been considered to meet the conditions laid down. . No first or second prize was given, but a third prize was awarded to L. Boireau.



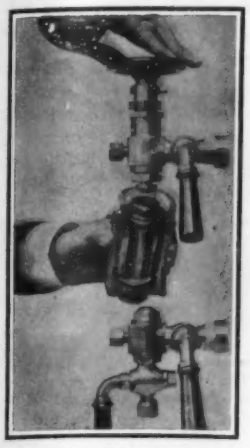
The Cloud of Snow Tossed by the Plow as It Plunges On.

The Largest Rotary Snow Plow in the World.

THE WORK OF THE ROTARY SNOW PLOW.

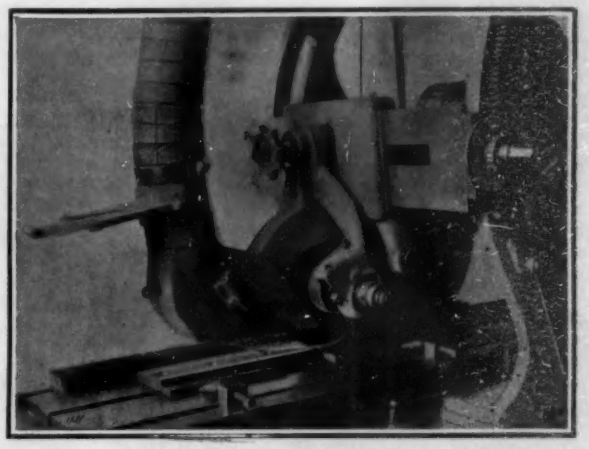
AN EXPOSITION OF SAFETY DEVICES AND INDUSTRIAL HYGIENE.

The general public realizes in a vague sort of way that nearly all industries are more or less dangerous to those engaged in them, and that a good many workers are killed or injured yearly in the pursuit of their vocations. Possibly it is better for the peace of mind of that curiously apathetic creature, the general public, that it is not more thoroughly familiar with the absolutely frightful cost of the "victories of peace." Every now and then the reports of the Interstate Commerce Commission upon the price of railroading in human life and safety arouse indignant press comment throughout the country. Unfortunately, the excitement soon passes away under the impetus and drive of our American life, and the whole matter is forgotten until—the next time. It is necessary for the welfare of the entire people that there should be an awakening and a recognition of the price in lives and suffering which we yearly pay for our industrial triumphs. The American Institute of Social Service has been actively engaged during the past few years in disseminating information concerning the terrible conditions obtaining, means for bettering these conditions, and data regarding the progress which has been made abread in methods of industrial safeguarding. To further this propaganda, an Exposition of Safety Devices and Industrial Hygiene will be held at the American Museum of Natural History, New York city, from January 28 to February 9, under the auspices of the American Institute of Social Science.



A Device to Prevent the Scattering of Fragments from an Exploding Gage-Glass.

How imminently necessary it is to awaken the public conscience in this regard is shown by an array of figures compiled by the Institute, which are positively staggering in their fearful magnitude. For instance, it has been shown that there are some 80,000 more people accidentally killed in the United States in four years, than all who fell in battle and died of wounds on both sides during the four years of our civil war. In other words, in the same length of time 53 per cent more people are killed in industrial occupations than two great armies could destroy in a war of exceptional bloodiness. Every year we are killing over twofold more than perished by violence in both the French and English armies during the Crimean war. It has been demonstrated that there are nearly 3,500 fatal accidents in New York city every year. The census for 1900 shows that during that year there were reported 57,513 deaths by accident and violence in the United States, with an accompanying number of non-fatal casualties many times greater. Without increase of the annual rate reported by the government in 1900, there will be 575,000 persons killed every ten years, besides some 5,000,000 injured, even if the proportion of accidents to the population should prove to be no greater in this country than that of France. According to President Strong of the Institute, this would be equivalent to massacring every inhabitant in three cities the size of Indianapolis, Kansas City, and Denver every ten years, and at the same time maiming and mangling every man, woman, and child in Washington, Oregon, California, Nevada, Utah, New Mexico, Arizona, Colorado, Wyoming, Idaho, Montana, and Oklahoma, and doing it every ten years.

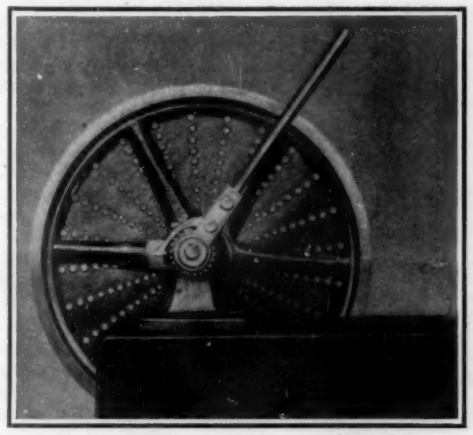


Dust-Absorbing Device for Surface-Grinding Machines.

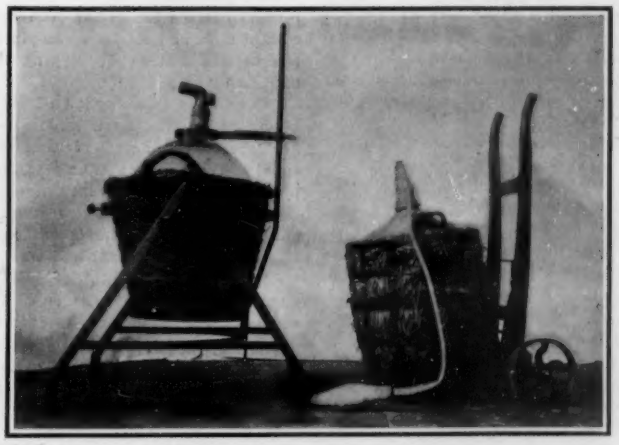
It would almost seem that the people of this country have either become reconciled to this terrible state of affairs, or are entirely ignorant thereof. It is undoubtedly true that many accidents cannot be foreseen, and are inevitable in spite of all possible precautions. Nevertheless, the work carried out by certain socfeties in Europe has shown that beyond question the greater portion of industrial accidents are preventable. We must not, however, imagine that accidents have been reduced to a minimum abroad. Statistics demonstrate that in Germany, a country remarkable for its thorough governmental supervision of industrial conditions, and painstaking care on the part of its employers to safeguard its workmen, of 15,970 accidents investigated, 53 per cent were avoidable. At that rate it is but fair to assume that in this country more than three-quarters of the accidents are preventable.

In most of the European countries social and industrial science of this character is far in advance of similar phases of human endeavor in the United States. There are numerous societies in France, Germany, Austria, Belgium, and Holland, devoting themselves solely to bettering the conditions under which the workman procures his livelihood. Among the best features of these associations are the permanent museums for exhibits of interest in this connection. Among these are the Paris Museum of Security, organized in 1905; the Berlin Museum of Security, organized in 1903; the Munich Museum of Security, organized in 1900; and the Amsterdam Museum of Security, organized in 1893. These societies carry out their purpose in the usual manner, by means of permanent and temporary expositions, regularly published bulletins and periodicals, and illustrated lectures.

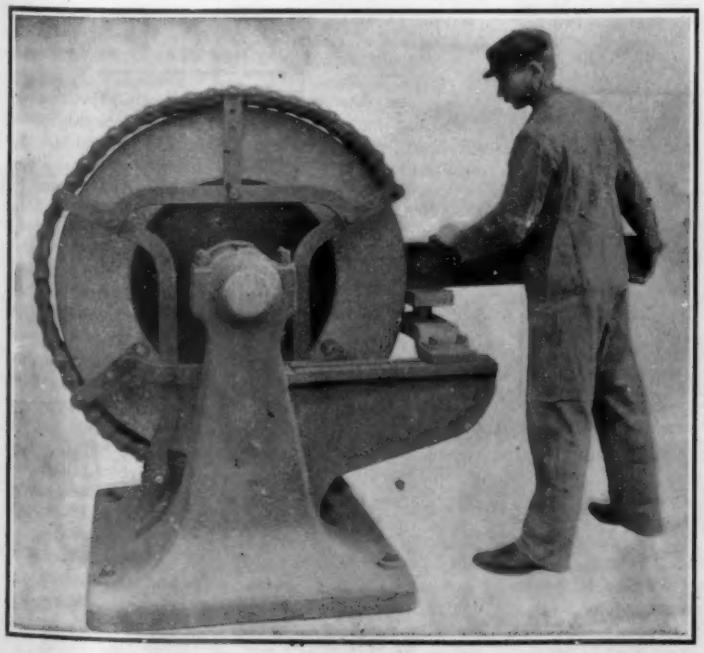
The attitude of so many of our manufacturers, who maintain that a man, foolish enough or careless enough



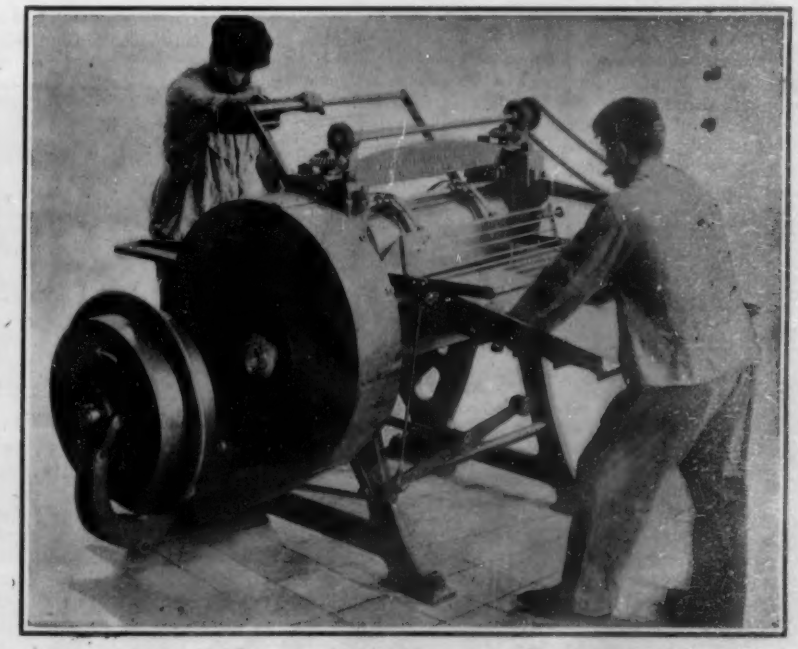
Device for Starting Gas Engines.



Guards and Holders for Acid Carboys.



Guard for a Heavy Grinding Machine. The Chain Prevents the Scattering of Fragments if the Stone Should Burst.



A Dough-Working Machine Provided with Device to Prevent the Fingers of the Operator from Being Crushed Between the Rolls.

to be injured in the pursuit of his vocation, deserves no sympathy and gets merely what he deserves, has been a great obstacle to the furtherance of industrial safeguarding of American workers. This attitude is more than shortsighted; it is almost negatively criminal. Human nature is not perfect, and the fact that we are human and are prone to ignorance or even carelessness and negligence, is but an argument in favor of making allowance for such very human weaknesses. Legally, it is considered the duty of the employer to furnish the employee with proper implements and a proper place to work. Should he fail to do so, he is liable for any resulting accident. And ethically, it is equally his duty to safeguard the worker from the results of his own failings, due to natural and human weaknesses. Until we learn in this country that human life and human security are of greater value than the material dollar, until we learn that it is *not* cheaper to fight damage suits than to incur initial expense in the prevention of industrial homicide, the seeds of progress in industrial security must fall largely on barren ground. Happily there are signs of a more general realization in the future of the terrible cost at which our commercial activity progresses. It is to be sincerely hoped that the forthcoming exhibition will arouse at least a tithe of the attention of which it is worthy, and that it will result in opening the eyes of some of our captains of industry to this terrible underlying phase of nearly all of our producing interests.

The accompanying engravings are indicative of the character of the propaganda as evidenced by the exhibition itself. The exhibits consist of devices for safeguarding the lives and limbs of workmen and preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. Many different types of machines are shown in operation, in the form either of models or of actual devices. With these are shown the safeguards to be used in connection with the machines. The section of industrial hygiene includes improved dwellings, methods for the prevention of tuberculosis and other diseases resulting from dangerous occupations, respirators and devices for supplying and maintaining pure air for the man working under conditions where this is necessary, and examples of first aid to the injured.

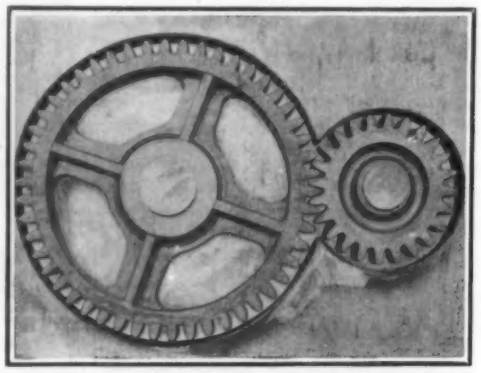
Among the safety devices exhibited are many ingenious and interesting constructions. They include a guard for large grinding machines, which is composed of a chain with large links through which is woven a long strip of steel. The chain embraces almost the entire circumference of the grindstone. The steel band stiffens the chain, which is mounted in place by lateral members of steel. If the grindstone should burst, it would be impossible for the fragments to fly off tangentially, and the lateral supports would prevent pieces from escaping at the sides. Another useful device illustrated herewith is a buzz-saw guard consisting of an adjustable frame which fits over the saw, and which is automatically displaced as the saw works its way into the wood which is being cut up. The wood itself gradually displaces the guard, and when the work is withdrawn, the guard returns to its normal position covering the entire saw. In many industries a dangerous feature is found in the ever-present dust, which is inhaled by the workmen and, in many cases, eventually leads to consumption and other diseases. One of the devices on exhibition is a dust-absorbing apparatus for a surface grinding machine. It comprises a box connected with a movable absorption pipe, through which an aspirator draws the dust. The box is mounted above the work close to the grinder.

Among the most unpleasant of the various accidents liable to occur in the shop is injury due to acids. The exhibition includes various guards and devices for sulphuric and other acid carboys. These devices prevent the breaking of the bottles, and permit of the easy decanting of the contents. Another safety device, which is of the greatest simplicity, but of the greatest importance, is the gear-wheel guard illustrated in another of the accompanying engravings. It consists merely of a metal band shaped to conform to the outline of the wheels, and mounted closely about their peripheries. This simple guard is very effective in preventing the workmen from coming into contact with the teeth of the moving gears.

Another device consists of adjustable gratings, which render it impossible for the operatives to have their hands injured by the rolls of a dough machine. The grating swings about the upper roll, and is so formed that the work can be slipped underneath it between the rolls, while at the same time it is impossible for the workman to pass his hand far enough under the grating to be liable to injury. The device is so constructed that the movement of the rolls is governed by the position of the grating, which thus serves not only as a guard, but also as a convenient means for governing the operation.

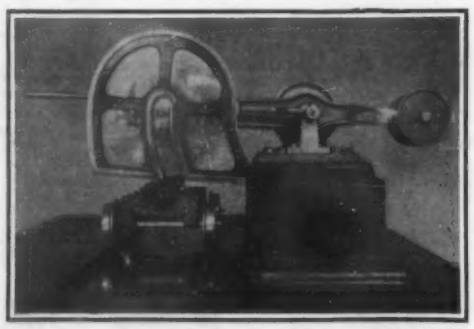
There is often an element of danger in the gage glasses used in connection with boilers, tanks, or other apparatus; for these glasses often burst under excessive pressure, and the flying fragments of glass thereby become projectiles which are dangerous, to say the least. One of the devices illustrated herewith is designed to prevent the hurling about of these glass fragments. It consists of a protecting casing of exceptionally strong glass mounted about the gage glass. A broken glass can be easily and expeditiously replaced with this device without interrupting the operation.

The object of this exposition is to direct the awakened public opinion to the necessity of active steps toward lessening the causes of accidents endangering the life and safety of the American workingman, and by means



Metal Guard for Gear Wheels.

of a permanent museum of security, where all problems of such safeguarding can be studied in working detail, to effect permanent industrial betterment.



An Automatically Lifting Buzz-Saw Guard.

AN EXPOSITION OF SAFETY DEVICES AND INDUSTRIAL HYGIENE.

The fact that zinc forms a good, cheap and durable coating for iron and steel made the wasteful hot process of galvanizing with all its disadvantages very profitable, and it is well known that zinc is far superior to tin or lead as a protecting medium, since it is electro-positive to iron and consequently it will be attacked before the iron when these metals are exposed to corrosion.

There are many valid reasons why the American electrolytic process of cold galvanizing, introduced by the Hanson & Van Winkle Company in this country, is better than the imported process of hot dipping; for instance, there is the all-important one of economy, since a large saving is effected in the metal; in many cases a deposit of one-tenth of the zinc used in the hot process will give better protection, owing to its uniform distribution as well as to the chemical purity of the zinc deposited.

In an electro-deposit of zinc the adhesion is perhaps even better than where the metal is applied hot and it is certainly more flexible, and if metal is in sheet form it can be more easily spun, or if in wire it can be twisted without the zinc coating splitting or cracking, while the temper of the most delicate spring can be maintained uninjured.

While dipping in the hot metal is the quickest when everything is in readiness, there is usually a saving of time by using the cold process, for it is always ready to operate and no time is lost, and an especially commendable feature of cold galvanizing is that it permits objects that are soldered to be coated. The work prior to being galvanized is cleaned as for nickel plating and other like operations when it is suspended in a tank, and almost all work can be given a protecting coat of zinc in from twenty to thirty minutes.

Zinc when it is deposited electrically is much more even and the coating more dense than can possibly be obtained by the hot dipping process.

Prof. Burgess has stated that the degree of protection offered by zinc is proportional to the thickness of the thinnest part of the coating, and therefore electro-galvanizing enables a greater protection to be obtained with a given amount of zinc than does the hot process, while the greater purity of electrolytic zinc, together with its greater density, gives it for equal thickness of coating an efficiency in resisting corrosion of 50 to 100 per cent greater than that of the hot process.

By using the electro-galvanizing process the thickness of the deposit may be controlled within comparatively wide limits, whereas with the hot process a very limited difference in thickness can be obtained and this only by increasing or decreasing the temperature of the molten zinc.

Where iron or steel objects that have lines engraved upon them, or have depressions cut into them are to be protected by galvanizing, if the hot process is used, the detail is lost by being filled in and the work must be gone over again, making it very expensive. Cold galvanizing acts diametrically opposite in that it does not fill up the depressions, however fine, but brings them out if anything more clearly.

As to the adhesive qualities of the deposits obtained by the opposed processes, there is probably little difference, though electro-metallurgical experts claim better results where cold galvanizing is used, but in either case the coating of zinc becomes closely allied with the iron or steel between the contact surfaces.

Cold galvanizing is now extensively used for zincing articles of steel, gray and malleable iron, ranging from screws and bolts to architectural iron. In addition sheet iron and steel, band steel, hoops, bicycle and automobile rims and spokes, telephone and telegraph fittings, and the like are being successfully treated.

A plant for electro-galvanizing comprises a low voltage compound wound dynamo, ammeter and voltmeter, connections, tank for solution, with fittings, solution or material for solution, cast anodes and a cleaning outfit for preparing work, all of which may be procured at small expense.

Cold Galvanizing for Iron and Steel.

BY A. FREDERICK COLLINS.

Cold galvanizing or electro-zincing is an American process devised for giving iron and steel a protecting coat of zinc, and this is accomplished by electroplating the objects instead of dipping them into a molten bath.

Prior to the introduction of the new process it was necessary to melt up a large amount of zinc and to heat the iron and steel to be treated to a temperature equal to that of the molten zinc, when the objects were plunged into the latter metal.

The older process offers numerous disadvantages, and among the most important may be mentioned that the strength of the iron and steel thus coated is often considerably reduced and that screws and other threaded fittings usually have to be recut. Again, there is a considerable loss of zinc by oxidation due to the high temperature required, while the iron tanks are in time destroyed, due to the combination of the heated zinc with them, and finally the operator can not control the thickness of the deposits.

On the other hand, the one advantage the hot process has over the electrolytic or cold one is that the slower rate with which the zinc is electrolytically deposited makes the initial cost of the plant more than for the hot process, but, as Profs. Burgess and Hambuechen have pointed out, it should be borne in mind that the cost of one cubic foot of electroplating bath is only a small fraction of that of the hot galvanizing bath. That is, one cubic foot of zinc weighing 400 pounds, has a value of about twenty dollars, while one cubic foot of plating solution can be supplied for about 50 cents, and the anodes to furnish the zinc to the bath may be roughly stated to be from one to two dollars per cubic foot of solution.

Superheater Trials on a Battleship.

The battleship "Britannia" is the first warship to be fitted with steam superheaters, and the analysis of the results of her trials is interesting, as it reflects light on the economy of the system. Six of the boilers in the "Britannia" had superheaters in the uptake, and as this number was equal to drive the engines at one-fifth of their power, it was decided to run two trials, each of thirty hours' duration, the one with ordinary steam and the other with the steam superheated to the extent of 90 deg. F. The result was to reduce the coal consumption by about 15 per cent, and to reduce also the temperature of the gases escaping from the funnel by 50 deg. In other words, with ordinary steam the coal consumption was 2.07 pounds per horse-power per hour, as compared with 1.77 pound while using superheated steam. Again, on the higher power trials the influence of the superheating of part of the steam had its effect as on the trial at 70 per cent of the power the coal consumption was 1.5 pound per I. H. P. per hour and at full power 1.83 pound. It is, however, at low powers that the gain is most wanted, as then the consumption is high owing to the auxiliary machinery taking such a large portion of the steam. Moreover, warships run for the greater part of their time at low power, so that if the gain of 15 per cent shown on trial can be maintained in service, the coal bill for the year will be appreciably lessened.—The Journal of Electricity, Power and Gas.

SOME MORE ELECTRICAL DEVICES FOR THE HOUSEHOLD.

In no discovery of the past few years has public interest been so centered and retained as in the application of electricity for domestic purposes. A year ago the first electrical house in Schenectady was the wonder of the world. To-day there are several homes in

Electric Chafing Dish.

the great Electrical City, and elsewhere, wherein all the heating, cooking, lighting, and power is supplied by electricity, and there are thousands of houses partially equipped with the electrical devices.

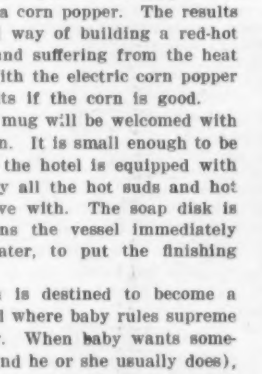
Invention and research have been constantly at work perfecting new devices to be installed in the electrical homes. The three very latest utensils are the electric corn popper, electric milk warmer, and the electric shaving mug.

Of the host of electrical household utensils, the new electric corn popper is the daintiest. Attach the connection with the electric light socket, and the children can pop corn on the parlor table all day without the slightest danger or harm. In a very few minutes after the switch is turned, the pan is hot enough for the corn. The device consists of a double aluminium vessel holding about a quart, with the heating units concealed underneath. A wire cover keeps the rapidly-popping kernels from flying out on the floor. The popper is mounted on two small rubber-tired wheels, making it easily shaken. The whole is vibrated with a short wooden handle. Nothing easier or simpler can be imagined in the line of a corn popper. The results are far better than the old way of building a red-hot fire in the kitchen range, and suffering from the heat while popping the corn. With the electric corn popper there can be no poor results if the corn is good.

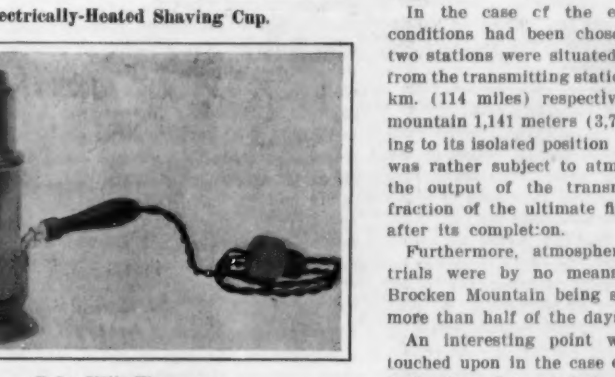
The new electric shaving mug will be welcomed with delight by the traveling men. It is small enough to be readily carried, and where the hotel is equipped with electric lights it will supply all the hot suds and hot water a man wants to shave with. The soap disk is easily removed, which turns the vessel immediately into a half-pint water heater, to put the finishing touches on the shave.

Another invention which is destined to become a necessity in every household where baby rules supreme is the electric milk warmer. When baby wants something to eat in the night (and he or she usually does), some one must get up and warm milk on the stove, else there will be no rest in the house that night. Now all this is changed. A turn of a switch at the head of the bed, and the milk, made ready before retiring, is instantly heating, and by the time papa has his feet in his slippers, it is warm enough to be given the child.

The electric chafing dish has been wonderfully improved, and the new utensil is the result of careful study and experiment. Welsh rarebits *a la* electricity are now easy enough. The new dish is of handsome design, and once connected with the electric light socket, the simple throwing of a switch prepares it for immediate use. There is no flame, soot, useless heat, danger, or giving out of "alcohol" at the critical moment. A kindred utensil is the electric coffee percolator, which is a very simple device. The steam generated under the bell valve forces the water and steam up through the tube into the glass globe, where it falls in the form of a fine hot spray on the ground coffee, and percolates back into the reservoir. The main features are its simplicity in operation and the perfect control of the heat. The coffee cannot boil or "cook." Consequently it retains its sweet aroma and its strength and color.



Coffee Percolator.



Electric Iron With Combination Switch and Plug.

SOME MORE ELECTRICAL DEVICES FOR THE HOUSEHOLD.

The Use of Wireless Telegraphy for Determining Longitude.

After special experiments made between Potsdam and Ober-Schöneweide (near Berlin) had shown that coherers used as wireless telegraphy detectors, really constitute instruments of precision, the Potsdam Geodetical Institute undertook investigations in order to test, on a large scale, a possible application of wireless telegraphy to the determination of longitudes. A convenient opportunity was afforded last summer by a determination of longitude between Potsdam and the Brocken (Hartz Mountains). These experiments in which a comparison as directly as possible between results secured by the ordinary method and wireless telegraphy respectively was to be obtained, were carried out by Prof. Th. Albrecht, in conjunction with some other scientists, and with the assistance of the German Postal Department. An exchange of signals was carried out both by means of ordinary and wireless telegraphy from June 21 to July 10 between Potsdam and the Brocken.

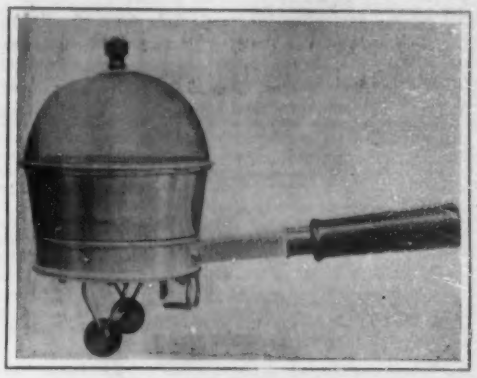
Wireless telegraphy signals were transmitted exclusively from the mammoth wireless telegraph station erected at Nauen, near Berlin, which is 32 kilometers (20 miles) distant from Potsdam and 183 kilometers (114 miles) from the Brocken Mountain. As in connection with these signals no compensation of current intensities (in opposition to ordinary telegraphic signals) could be obtained, such tests had to be extended to different current intensities (viz., full, half and one-quarter respectively of the energy of electric

Electrically-Heated Shaving Cup.

Baby Milk Warmer.

waves sent out from the station) while a considerable number of couples of coherers was used in order to eliminate any defects of individual apparatus. A number of more or less extensive series of observations was obtained on eleven evenings, five days being lost on account of outside disturbances, while the disturbance due to atmospheric electricity was so considerable on four stormy days as to prevent any wireless telegraph service between the two stations.

From the extensive experimental material it is inferred that the degree of accuracy of the individual signals, both in the case of ordinary and wireless telegraphy is 0.02 second, and that of the definite clock difference in the case of ordinary telegraphy (120 signals



Parlor Corn Popper.

being given during each evening) 0.002 second, and 0.003 with wireless telegraphy in the case of 50 signals each time.

No differences in the working of the coherers could be noted, while departures between the two kinds of signals remain within the order of one-thousandth second. In any case the readings should be extended to several series of signals using different coherers.

By comparing the results obtained by Prof. Albrecht in the case of full, half and one-fourth energy of the electric waves respectively, the very remarkable result is obtained that there is no variation of the resulting clock difference due to the current intensity.

In order to allow as many signals as possible to be recorded, Prof. Albrecht recommends using, in the case of such determinations of longitude, an excess of electrical energy in connection with fairly large antennæ. In order, on the other hand, to compensate the influence of atmospheric disturbance in the case of antennæ of greater capacity, the coupling between the primary and secondary coils should be as loose as possible.

In the case of the experiments referred to all conditions had been chosen rather unfavorable. The two stations were situated at rather unequal distances from the transmitting station—32 km. (19 miles) and 183 km. (114 miles) respectively; one being located on a mountain 1,141 meters (3,742 feet) in height which, owing to its isolated position and its marshy surroundings was rather subject to atmospheric disturbances, while the output of the transmitting station was only a fraction of the ultimate figure which will be obtained after its completion.

Furthermore, atmospheric conditions during these trials were by no means favorable, the summit of Brocken Mountain being surrounded by clouds during more than half of the days of observation.

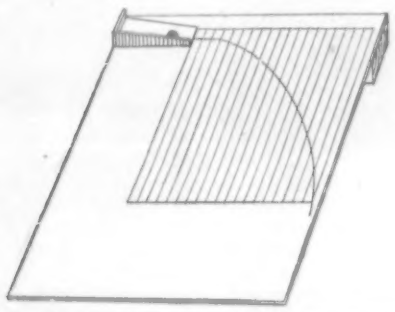
An interesting point which has not so far been touched upon in the case of wireless telegraph signals, is the time of transmission of the current. It has been generally supposed that electric waves are propagated at the speed of light. If this be true, a difference in distance amounting to 151 kilometers (93 miles) would correspond with a time of current transmission of one two-thousandth part of a second. Now by comparing the results obtained with the aid of either wireless or ordinary telegraphic signals this figure is found to be actually true. From the above experiments it is inferred that wireless telegraphy is fully able to replace ordinary telegraphy for the practical determination of longitudes.

The average daily supply of water delivered to London from the Thames River during August last was 138,599,861 gallons; from the Lea, 42,085,000 gallons; from springs and wells, 67,077,451 gallons; from ponds at Hampstead and Highgate, 3,000 gallons. The daily total was therefore, 247,765,312 gallons for a population estimated at 6,840,367, a daily consumption per head of 36.22 gallons.

Patent Department

LAWS OF FALLING BODIES

A unique device for illustrating the laws of uniformly accelerated motion, composition of motions, trajectories, etc., has been recently brought out by John C. Packard, Science Master, High School, Brookline, Mass. A steel ball, one inch in diameter, placed at the top



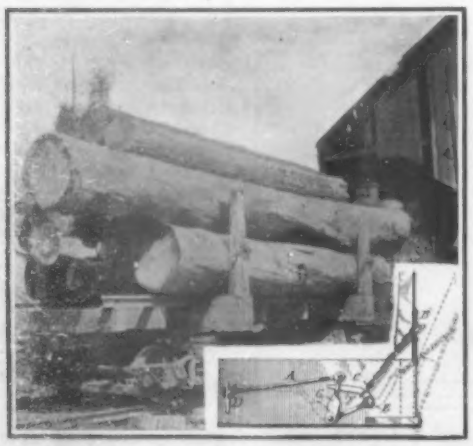
DEVICE ILLUSTRATING LAWS OF FALLING BODIES.

of an inclined plane of wood or of plate glass, is given an initial velocity at right angles to the slope of the plane, by being compelled to roll down an auxiliary incline behind a ledge, and is then allowed to roll down the plane. The path of the ball being the resultant of uniform and uniformly accelerated motion is, of course, a parabola. To secure a tracing of this curve, a piece of co-ordinate paper is secured to the plane, and a piece of soft carbon paper of the same size is placed over it. The ball, in rolling over the transfer sheet, leaves its mark upon the co-ordinate paper. Any number of duplicates can be made by repeating the experiment under precisely similar conditions, or the curve may be varied at will by changing the incline of the principal plane, the auxiliary plane, or both. Measurements made upon the curve thus traced will readily reveal the laws of uniformly accelerated motion, and the fundamental principles underlying the phenomena of falling bodies.

A pendulum attachment, not shown in the illustration, may be used to determine the value of the time interval in seconds if desired.

A SAFETY TRIP FOR LOGGING CARS.

Logging cars or trucks as usually constructed comprise a bed or platform with removable stakes at the sides for holding the logs in place. The stakes are commonly held in upright position by means of stake chains, and when it is desired to unload the car, these chains are released, permitting the stakes to swing outward and the logs to roll off. In order to avoid any danger to the operator when releasing the stake chains, Mr. Joseph W. Gray, of Evenwood, W. Va., has invented a safety trip of simple design, which is illustrated in the accompanying engraving. As shown more clearly in the detail view, the trip mechanism is operated by the rod *A*. The stake carries a hook *B*, over which the chain passes. The latter is made fast to the car body at one side of the stake, and at the other side it is hooked over a finger *F*, hinged to the bolt *E*. A lever *G*, also hinged to the car body, is formed with an eye adapted to receive the end of the finger *F* while it is holding the chain *C*. The rod *A*, which is connected to the end of lever *G*, serves to move the latter into or out of engagement with the finger *F*. When in engagement with this finger, the rod is locked by securing its outer end on the pin *D*. This pin is formed of two members, one of which is fixed on the car body, and the other is hinged on the fixed member, so that after the rod has been passed over the pin, the hinged member may be moved at right angles to the fixed member, as illustrated, and thus prevent the operating rod from accidentally slipping off. When it is desired to release the chain *C*, the hinged member is moved into alignment with the fixed member, the rod *A* is slipped off the pin and drawn back to the position shown by dotted lines, withdrawing the lever *G* from engagement with the finger *F*, and permitting the chain to slip off the finger. The stake will then swing outward under pressure of the logs carried by the car.



A SAFETY TRIP FOR LOGGING CARS.

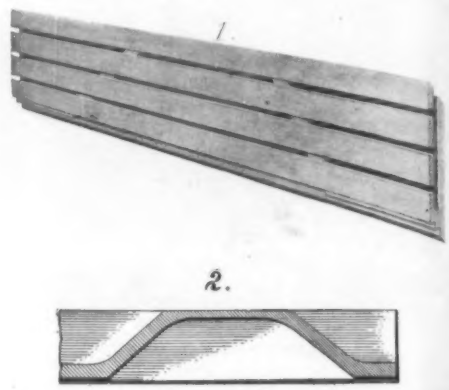
Brief Notes Concerning Inventions.

The sectional bookcase was a success from the start and it was not long before the principle was utilized in the manufacture of filing cabinets and other similar devices. Now the idea has just been seized upon by a designer of showcases and it is one which will be welcomed by many store keepers. A merchant entering on a new line as an experiment is enabled to purchase two or three units which will meet his immediate needs and not represent any great investment of money and by the addition of another unit or two he can increase the capacity of the pyramid as he desires. These cases offer ample means of protecting delicate goods from dust or from undue handling on the part of prospective customers and at the same time the contents are easily accessible. The base of the show case pyramid consists of a rather heavy piece containing one or two drawers. On top of this may be placed one or more smaller units each fitted with a glass front of the disappearing type. The latter being raised and pushed out of the way reveals two tray-like drawers which may be pulled forward for the display of the contents. As a variation on this, another style consists of a single deep compartment which is particularly suitable for topping the pyramid.

Certain recent improvements have been made in the interlocking tile. Heretofore, the clay tile has been handicapped by the fact that it was made only in red, which restricted its use where architects were endeavoring to follow a color scheme to which this color did not lend itself. Recently this drawback has been removed by the manufacture of these tiles in several different shades and colors, principally green, buff, and brown, and this alone will greatly enlarge their field of usefulness. Another important advance has been the manufacture of glass tiles, and by their use it is possible to put a transparent roof on a factory, studio, or other structure where plenty of light or an overhead light is desired. In this capacity the glass tile has already been successfully used as a substitute for the skylight, particularly in the covering of factories and workshops. In such establishments where fumes are constantly arising, the life of the skylight is quite short, for the reason that the metal work used in skylights quickly deteriorates and must be renewed frequently. In some cases it lasts but three years. With the use of the glass tile a superior light may be secured without the necessity of any break in the roof whatever. The tiles are here used in conjunction with the clay tiles, the transparent ones being inserted wherever desired and in any design. It is claimed that a skylight of any size or shape may be replaced with glass tiles, and the same amount of illumination will be obtained from one-quarter of the area of the old skylight. This is due to the fact that the shape of the tiles causes them to act as prisms and thereby greatly increase the amount of light transmitted. Tiles for roofing were first introduced about fifteen years ago and have proven to be durable and desirable in every particular. They cost about the same as slate, but last much longer.

SHEATHING LATH.

Illustrated in the accompanying engraving is a combination of sheathing and laths adapted for plaster or stucco work on walls or ceilings, which is so constructed as to offer the least possible obstruction to the plaster keys and a maximum of bearing or locking surface. The laths and sheathing are formed integral but are separated from each other by means of diagonal ribs. The article is formed from a board of suitable thickness, in the edges of which, at opposite sides, saws are introduced to produce kerfs. The opposite kerfs do not meet but are arranged to leave the diagonal ribs, as shown in the sectional view. The laths are now formed by running saw kerfs from end to end of the material at its inner face, these kerfs being equally spaced and of uniform width. The upper and lower edges of the article are oppositely beveled, so that abutting sections will be effectively interlocked. It will be observed that by this means, each lath, although connected to the sheathing by the diagonal ribs, is yet largely independent of this connection, so that there is less liability of obstructing the plaster keys than when ordinary laths are employed. Each lath is capable of being practically surrounded on all sides by plaster and, owing to their uniform and regular spacing, the laths offer a much better surface on which the plaster may be laid. In ordinary work, plaster is often forced between and back of the laths to such an extent as to fall down and be of no service. The uniform spacing of the laths in the present construction obviates such a waste of material. A greater solidity is given to the wall by reason of the strong and compact combination of the two thicknesses of wood alternating with the plaster. Furthermore, the



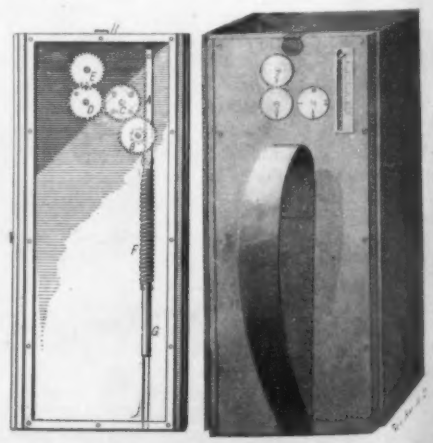
2.

SHEATHING LATH.

completed wall will present a more even plastered surface, together with a strong combination of heat and cold resistance. The inventor of this improved sheathing lath is Mr. Eugene S. Crull, of Sedalia, Mo.

IMPROVED MEASURE FOR FOAMING LIQUIDS.

While it is the universal custom to sell beer by measure, yet with the ordinary measures neither the customer nor the dealer knows just how much liquor is being dealt out, owing to its excessive foaming. However, a new type of measure has just been invented, which aims to overcome this defect by indicating the weight of the liquor contained in the vessel. Furthermore, a dial is provided on which the price of the measured quantity of beer is indicated, while other dials serve to keep a permanent register of the amount of sales. The improved measure comprises two principal parts, namely, a measuring vessel and a casing connected therewith, in which the weighing and computing mechanism is housed. The measuring vessel is secured by a bracket to the rod *G*, which at its upper end is formed with a rack *A*. A coil spring *F* serves to connect the rod *G* with the chamber. The rack *A* meshes with a pinion carried by the gear *B*, while the latter engages a gear *C*. The gear *C* carries a series of dogs, as indicated by dotted lines, which engage the teeth of the gear *D*. The latter is formed with a pin, which at each revolution moves the gear *E* through a measured distance. The handle of the measure is attached to the casing, and the latter normally supports the measuring vessel by means of a latch which is controlled by the trip *H*. In use, after the measure has been filled with liquor, the trip *H* is pressed to release the latch, whereupon the weight of the liquor causes the rack *G* to move downward in the casing against the pressure of the spring *F*. This causes the gears to rotate in proportion to the weight of the liquor. The exact weight is indicated by a pointer on the rack, which travels over a scale. The gear *C* operates a dial which indicates the price of the measured liquor, while the gears *D* and *E* are also operated to add this price to the totals of the previous sales. After the liquor has been poured out all the parts return to normal position, with the exception of gears *D* and *E*, which remain idle owing to the fact that the dogs on gear *C* are inactive when the latter gear is returning to its normal position. The inventor of this improved liquid measure is Mr. Frank W. Havlicek, of Twin Falls, Idaho.



IMPROVED MEASURE FOR FOAMING LIQUIDS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

CHILD'S CAP.—LENA STEINTHAL, New York, N. Y. The purpose of the invention is to provide a construction of child's cap and one wherein the parts of the cap are permanently connected and are capable of being laid flat for purposes of washing, starching, and ironing and wherein, further, the parts may be quickly and conveniently drawn together and secured to form the front and back sections of a child's cap, the two sections being needed for the cap's formation.

Of Interest to Farmers.

MILKING-MACHINE.—L. B. STEVENS, Logansport, Ind. A person on the stool by moving a lever downward will cause a downward movement of a piston, and as the valves carried thereby will be closed the milk will be drawn from the udder, and then upon an upward movement of the piston the valve opens, permitting the milk to pass to the under side of the piston, and then by a subsequent downward movement the milk underneath the piston will be forced through a pipe and at the same time a fresh supply of milk will be drawn.

JOINTER FOR STUBBLE-PLOWS.—D. H. DICKINSON, Parker, Ore. The purpose of the invention is to provide an adjustable rolling jointer for stubble-plows which is economic in construction, and which will leave a clean furrow, turn all material from the plow-beam, and effectually prevent material clogging on the beam back of the moldboard, and which will also turn all stubble, weeds, and grass cleanly under the furrow.

Of General Interest.

BUILDING-BLOCK.—J. AITKEN, New York, N. Y. The object of the inventor is to provide a building-block for the construction of walls arranged to insure the formation of light and air-tight joints and to reduce the weight to a minimum and still render the block exceedingly strong and durable and to provide the block with air-spaces to prevent the penetration of moisture into a room by way of the wall.

SAFETY-ELEVATOR.—J. HART, New Orleans, La. In the present patent the invention has reference to elevators or lifts; and the purpose of the improvement is the provision of a safety device which will operate automatically to prevent the cage or car from falling in case of any breakage of the suspending-cable.

BURIAL-VAULT.—A. H. HAVARD, Urbana, Ill. One of the embodiments of the invention consists of a box-like structure built of concrete and having brace-bars imbedded therein, the whole having an inner rabbeted upper edge combined with means for lowering this part of the vault after it is dry and hard into the grave. A metal top fits into the rabbeted edge of the box-like structure and is placed thereon after the casket is placed in position. Thereafter the metal top is covered with green concrete, which knits to the lower portion of the vault and forms a hermetically-sealed case.

SCOOP.—F. C. HOWE, El Paso, Texas. The object of this inventor is to produce a scoop provided with means for weighing the contents of the scoop, the general purpose being to do away with the necessity of placing the substance within the scoop in a scale for weighing the same. The improvement refers to scoops such as used in stores and similar places in selling products, such as flour, sugar, etc. Mr. Howe has invented another scoop such as used as above; and the object of the improvement is the provision of a construction, having a handle or bail attached thereto, with means for determining the weight of the contents of the scoop.

DRAFT APPARATUS.—T. W. HUCKLE, Standish, Mich. The apparatus comprises a body to which power is applied, and is arranged to roll or climb along a holding element, this body having adjustably attached thereto means for connecting it with the weight, so that as the body is moved along the holding element power is applied to the weight. By adjusting said means for connecting the body with the weight the power of the apparatus may be increased or diminished.

PROCESS OF MAKING TERPIN HYDRATE.—L. H. REUTER, New York, N. Y. The hydrate produced can be used as a basis for the manufacture of other turpentine derivatives and that by the use of this new process an important industry can be developed in the United States which has heretofore been exclusively carried out in foreign countries. Certain raw and waste products can be employed which have heretofore had to be refined and imported.

SAFETY-RAZOR. — W. SCHMACHTENBERG, New York, N. Y. The object here is to provide a razor which is simple in construction, composed of but few parts, not liable to easily get out of order, and arranged to permit minute adjustment of the blade to bring the cutting edge thereof in proper relation to the guard, and to hold the blade positively against rearward motion to maintain the cutting edge in the adjusted position.

FASTENING FOR HANDLES OF BAGS, SATCHELS, PURSES, ETC.—H. B. WELCH, West Hoboken, N. J. Heretofore handles of bags, satchels, etc., especially of fastenings which involve the use of a bearing having a swivel connection for attaching a handle, have been attached by inserting the ends thereof in sockets, the ends being held in the sockets each by a transverse pin. That fastening is defective, as the pins pull their way out through the handle ends. Mr. Welch produces a fastening by means of which the handle may be quickly attached and secured.

PACKAGE-HANDLING DEVICE. — W. R. DENNIS, Denver, Col. By moving a sleeve downward on a staff the jaws will spread apart so that they may be engaged with a box, package, or the like. Then upon releasing the sleeve the springs will move the jaws toward each other to engage with a box, package, etc. In shifting paper or pasteboard boxes, it is not desirable that the jaws shall clamp closely against the same while the box is resting on the hangers. To provide for this, the sleeve may be rotated so that the cam mechanism will lock the jaws at a suitable distance apart.

Heating and Lighting.

COMBINED HEATING AND COOKING STOVE.—J. I. HAMAKER, College Park, Va. By means of the present invention the improved stove is so constructed that it may be produced at a small cost. It practically contains an oven, a water-heater, a steam-cooker, and a warming-chamber, all arranged with a view to the greatest economy of heat and consequently of fuel.

Household Utilities.

STIRRER.—I. W. GREENWALD, Frederick, Md. The invention refers to stirring or agitating attachment for cooking-kettles, and has for its object means of this character which may be simple in construction and applicable to all open kettles commonly employed for cooking apple-butter or general purposes where the fluid or material should be stirred or agitated during the cooking process.

DUSTLESS BROOM.—J. R. PRICE, Fond du Lac, Wis. The object of the invention is to construct the device in such a way that it will prevent the raising of dust when in use, and a further object is to construct so as to enable the handle to be adjusted upon the body of the brush and also to construct the body of the brush in such a way as to enable the straws or bristles to be easily reversed or replaced when worn.

Machines and Mechanical Devices.

HEATING DEVICE FOR SPINNING-LATHES.—R. THIEL, Lubeck, Germany. The invention refers to improvements in heating devices for spinning-lathes whereby it is rendered possible to maintain the device at a proper and uniform distance from the blank while the latter is being spun—that is to say, during the reduction or increasing of the diameter of the respective part of the blank—so that the metal is at all times heated up to the right temperature and cannot become brittle and cracked.

ROAD-GRADER.—E. FAHRNEY, Deep River, Iowa. A purpose here is to provide a machine that will plow and grade a road at the same time, in which a series of spades have rotary co-operative action relatively to the plow, cross-cutting the furrow as turned up by the plow, which spades when they reach a certain point at rear of machine under action of trip devices consecutively throw the dirt inward with such a quick motion that they scatter dirt in direction of the middle of the road, thus making it smooth, the spades acting equally well in dry, soft, soddy, or weedy roads.

PILE-FABRIC LOOM.—H. SARAFIAN, Yonkers, N. Y. Mr. Sarafian's object is to provide a loom for weaving pile fabrics—such, for instance, as are shown and described in the Letters Patent of the United States formerly granted to him and bearing Nos. 752,712 and 782,178. In order to produce the weave, it is necessary to manipulate three warp-threads of each set in a peculiar manner and relative to each other, and for this purpose a special device is used. In operation of the loom the thread on the bobbin of the shuttle unwinds to form a weft-thread at the time the shuttle goes through the open shed from one side of the loom to the other, and when the shuttle returns the same thread on the shuttle-bobbin forms a certain weft-thread.

SAWING-MACHINE.—S. J. GRAY and J. HORNING, Oakland, Cal. This machine is easily transported from place to place and is supported directly by the object to be sawed, thus dispensing with considerable weight. It may be positioned to cut at an angle upward or downward or may be reversed upon its plates when sawing close to the roots of the tree. Any suitable means may be used for imparting motion to the driving-pulley. Any preferred form of endless saw may be used with the machine.

LOADING-MACHINE.—F. K. HOLMESTED, Claremont, W. Va. The machine transfers any class of loose material from the ground or a platform into a conveyer, its object being to produce a device expeditious and efficient in operation. The invention consists, broadly in a revolving wheel or platform adapted to receive the loose material and discharge it upon a conveyer. The platform is set at a slight incline to the horizontal. A revolving plate combines with a side plate and conveyer-belt disposed across the upper face of said plate.

VARIABLE-SPEED GEAR.—C. E. FUNK, Enterprise, Ore. The invention pertains to variable-speed gears, and is especially useful in connection with machines for shearing sheep and the like. The object is to provide a transmission-gear, which permits the speed of the operating parts to be varied within wide limits and which allows the mechanism to be stopped or started by a simple motion of the operator.

HAND-POWER PROPELLER.—N. JOHNSON, Chicago, Ill. In this case the invention has reference to hand-power propellers, and has for its object the provision of means for propelling small boats upon park-lakes and similar places without the use of oars, and thereby enable such boats to move about freely, without interfering with each other.

CIGAR CUTTER AND LIGHTER.—F. A. WIDMANN, Philadelphia, Pa. One purpose here is to provide a form of cutter and lighter wherein a tension-controlled fountain for liquid fuel, such as gasoline, is provided with a wick for ignition and pivotally mounted upon the base for movement to and from the sparking device in an electric circuit the batteries whereof are concealed in the base, so as to produce a spark at the exposed portion of the wick as the fountain is swung outward to light a cigar, the current being closed and opened at moment of passage of the fountain to and from contact with the sparking device.

BALL-BEARING.—J. F. SPRINGER, Girard, Pa. The object of the invention is to provide a bearing arranged to insure a true rolling motion of the balls, unaccompanied by sliding between balls and bearings, to bear heavy strains, and to allow convenient adjustment with a view to taking up wear, and more especially designed for use on journal-bearings and the like, in which the main portion of the strain is approximately perpendicular to the axis of the shaft.

LABELING-MACHINE.—A. MARCUS, Shreveport, La. In operation a bottle or package is placed on a seat. A label is then taken off the pile and is passed over an exposed surface of the pasting-roller from left to right to apply the paste, and the label thus charged uniformly with paste or glue is by continuation of the same movement quickly slipped onto the bottle in about the same plane, thus getting the label on the bottle immediately after pasting it and before it has time to curl up. Location of labels on bottles is uniformly the same by the indication afforded by the marker.

AUTOMATIC WEIGHER.—A. MCLEOD and J. H. MCLEOD, Marietta, Kan. The grain is received into a stationary hopper and discharged therefrom into a movable weighing-hopper which is so connected with weighing and other mechanism that when filled it tilts automatically and the weight is duly recorded or registered, the hopper being then automatically restored to its first position, whereupon it receives another charge of grain and tilts and discharges as before. It is an improvement upon the weigher for which the inventors formerly received Letters Patent.

Prime Movers and Their Accessories.

STUFFING-BOX.—M. BERECKY, New York, N. Y. The object of the invention is to produce a box which will present a metallic packing and absorbent or vegetable packing and in which special provision is made for conducting the lubricating fluid to the vegetable packing. It relates to stuffing-boxes such as used for pistons, tail rods, and similar moving parts.

METALLIC PISTON PACKING. — N. PFLAUM, Pittsburg, Pa. The invention pertains to metallic piston-packings, such as shown and described in Letters Patent of the United States formerly granted to Mr. Pflaum. The object of the present invention is to provide a packing composed of comparatively few parts and arranged to prevent leakage of steam in the cylinder from one side of the piston to the other and to compensate for all wear of the interior contacting surfaces of the engine-cylinder and the piston-packing, thus requiring no reboring of the cylinder.

Railways and Their Accessories.

SAFETY APPLIANCE FOR AIR-BRAKES.—W. H. WINKS, Baltimore, Md. In this case the improvement relates to safety appliances for air-brakes, and has for its object to provide means whereby the brakes on a locomotive and train of cars will be quickly applied when a switch is open or a danger-signal set should the engineer from any cause fail to note the open switch or danger-signal.

RAIL-BRACE.—W. M. JENKINS, Guthrie, Oklahoma Ter. The brace securely fastens rails to the cross-ties. The brace has an anchorage underneath the tie. There are many advantages. Each tie is firmly anchored at each end to the two rails, so that the rail is immovable against all strains. There is great saving in spikes, and as the ties are not pierced at any point their longevity is greatly increased. Stability of the track also increases safety of travel and avoids much loss of life and property. Tension of rail-joints is maintained which deadens sound and avoids all initial looseness. The brace will allow the height of the rail to be increased without danger of the rail turning.

RAILWAY-TIE.—E. A. RASMUSSEN, Hot Springs, S. D. In this patent the invention has reference to improvements in metallic ties and rail-fastenings for railways, the object being the provision of a metal tie that will be comparatively light, yet strong and serviceable, and having novel means for securing the rails. The tie is inserted in the road-bed and the interior filled or packed with dirt, cement, or the like.

COMBINED TIE AND RAIL-FASTENER.—E. P. BELGMAN, Concordia, Kan. The improvement pertains to metallic railway-ties and means for securing the track-rails. The object had in view is to provide a tie and rail-fastening means which shall afford improved securing means for the rails and prolonged use of the tie over all similar ties and rail-fastening means.

METALLIC TRUCK FOR RAILROAD-CARS.—F. GEBHARDT, Alliance, Ohio. The invention refers to trucks for cars such as shown and described in the application for Letters Patent of the United States formerly filed by Mr. Gebhardt. The object of the present invention is to provide a truck for cars which is exceedingly strong and durable and arranged to provide a solid bed for the car-body to rest on and to readily accommodate the draw-bar timbers.

Designs.

DESIGN FOR A FRAME.—G. H. RICE, New York, N. Y. In this ornamental design the inventor produces a form of almost a true circle in the interior of the frame. Exteriorly the frame presents an almost square appearance secured by the four corners being extended and capped with scrolls. Mr. Rice has also designed another frame with nearly identical lines and scrolls (the latter six in number), excepting that the frame adopts an oval interior and an oblong outer form.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(10331) A. C. L. asks: Is it possible to convey a current of electricity from a battery, stored in a locomotive, to the rail, through the axle and wheel? Does not the oil bearing interfere with a perfect connection? A. We presume it is possible to convey a current of electricity from the locomotive to the rail through the axles and wheels, though we never tried the experiment. We think so, because the current from the overhead trolleys goes through the motor and the axles to the rail and returns to the power house in that way only.

(10332) W. J. C. wishes to know how to remove indelible ink marking from clothing. A. Indelible inks are of such variable character that it is quite impossible to reply. Many of these inks have nitrate of silver as a basis; in this case, a solution of hyposulphite of soda might help. Some other inks might possibly be bleached out with javelle water and weak muriatic acid; this can be used only on white goods, as most dyes would be destroyed. Possibly also a solution of sulphurous acid might be of service.

(10333) G. B. D. asks: Can you tell me how to construct a lamp or light that will burn under water (outside of an electric device). Any hints how to proceed will be appreciated. A. Any lamp will burn under water if protected from the water and supplied with air. We do not know any other way to produce a light under water. An electric light does not need air, a fact which renders it easier to have light under water by electricity, but this is out of the question with you. The metal potassium will burn under water. No means has been devised for utilizing the fact for illumination. Its cost is too great for such a use.

(10334) K. T. asks: 1. Is it possible to synchronize a dynamo and a motor, the latter run by the former, with reliability as to small variations of speed? A. The single-phase motor must closely synchronize with the dynamo which furnishes the current. Direct-current motors need not do so. 2. If so, will you give directions for building a simple and inexpensive model to illustrate the fact? For my purpose the minimum speed would be about 600 revolutions a minute and the maximum 2,400. The sensitivity ought to be such that

any small variation of speed in the dynamo is transmitted to the motor with reasonable accuracy. A. The simplest model you can have to illustrate this is two similar machines, one driven as a dynamo and the other turned by it as a motor. 3. Can a 110-volt direct-current readily be transformed to a 52-volt alternating of any frequency, and how, with the lease expense? A. A direct-current 110-volt is readily transformed into an alternating current of 52 volts pressure by a rotary converter such as is used in stations for this purpose. 4. Can a 100-volt direct current be used for heating metals by immersing in water, and how? A. A 110-volt direct current is not of a pressure high enough to heat metals quickly in water, as in the water pail forge; 220 volts are needed. Salt water is put into a pail in which a lead plate forms the electrode, while the iron attached to the pole is inserted into the water. It is instantly made red hot.

(10335) W. A. B. asks for a formula for glaze or glazing used in the manufacture of candies and crackers. A. Boil sugar and water to a point just before it will pull out stringy between the fingers. Dip in this solution.

(10336) C. R. says: If I were to take a cannon 3 inches in diameter and 1 inch bore and fit a screw cap firmly on the mouth of it, and then explode a piece of guncotton within, while the cap is screwed on: 1. Would the cannon burst? A. Plugging up a cannon charged with guncotton is a dangerous experiment. The charge would burst the cannon or blow out at the vent. 2. After cooling it would there be any explosion upon unscrewing the cap? A. There will be no danger in opening the cannon after explosion if it did dot open itself. 3. Do you think the heat generated within the cannon would be sufficient to melt an iron or brass screw ¼ inch or ⅛ inch in diameter? A. The heat of the explosion is too quick to melt the screw.

(10337) W. M. C. says: I have a brass coil boiler, in which there is a great deal of sediment and scale and which is steaming poorly; please advise me what preparation I can clean it out thoroughly with. A. You can clear the sediment and incrustation in your boiler by injecting a strong solution of caustic soda, say 10 per cent of the contents of the boiler, using it for the day; then blow out while steam is up, and repeat for a few days.

(10338) C. G. asks: How can I remove nitric acid stains from a blue cloth coat and bring it back to its former color? The acid having been dropped on the cloth and pressed with a smoothing iron, causing the part of the cloth where the acid dropped and was pressed to turn yellow. A. The stain caused by nitric acid on blue cloth can be removed by the *immediate* use of ammonia, in case the acid was weak. Strong acid will usually give a permanent stain. With an old stain from nitric acid nothing can be done.

(10339) J. L. B. asks: 1. What battery shall I use, and how many cells of the same, to light two 8 candle power lamps of 8 volts and 2 amperes? A. Five cells of the plunging bichromate battery will light two 8-volt 2-ampere lamps. The battery is described in Scientific American Supplement No. 792. 2. Why is the magnet in a telephone receiver permanent? A. The magnet in a telephone is permanent in order to furnish the field of force which causes the current in the transmitter to vary with the vibrations of the diaphragm. An electro-magnet would be more expensive and difficult to maintain. 3. What is the difference in construction of a direct current and an alternating current motor? A. A direct-current motor has a commutator, an alternating-current motor has rings to receive the current. The windings of the alternating-current motor are designed for the forms of current, as single or multiphase, while in some forms there is only one set of windings. To learn all the points of difference you should study the books on the subject.

(10340) C. T. M. asks: What is meant by a twenty per cent grade? A. A twenty per cent grade rises or falls 20 feet for every 100 feet measured horizontally and not on the slope. In other words, the grade is measured by the tangent of the angle of inclination and not by its sine, so that a 100 per cent grade corresponds to an inclination of 45 deg. and not to an inclination of 90 deg. A slope, as of an embankment, is usually designated as of so many to 1; for instance, the usual slope of earthwork is 1½ to 1, meaning 1½ horizontal to 1 vertical. But, conversely, the grade of a road is sometimes given as of 1 in so many, meaning a rise or fall of 1 foot vertically for so many feet measured horizontally; for instance, a grade of 1 in 20 would be a 5 per cent grade and of 1 in 5 would be a 20 per cent grade. You will find such matters explained in Trautwine's "Civil Engineer's Pocket Book." Price $5.

(10341) F. W. H. asks: I wish to make an electro-magnet with the greatest lifting power possible to be furnished current from a 110-volt 75-ampere plating dynamo. What size and how much wire should I use, and what size and length of core? Do you think such a magnet could be so insulated as to be used under solution for raising iron articles from bottom of tanks? A. A magnet can be made which will lift any weight from nothing up to several tons with the current named above, provided the armature were in contact with the poles of the magnet; but to draw articles from the bottom of a tank through an open space, that is, a space not filled with iron, is a different matter. It would require an enormous power to lift a very small weight from the bottom of even a shallow tank. The method proposed is not economical or practical. Better fish them up in the old-fashioned way.

(10342) G. M. T. asks: In still air will two spheres of the same size, one of aluminium and one of lead, fall from a given height in the same time? A. Since the velocity of a freely falling body is dependent only upon the mass of the earth, it follows that all bodies will fall in a vacuum with the same velocity, viz., 32.16 feet at the end of the first second of fall; and since the air will resist two spheres of the same size equally, because they displace the same weight of air, it follows that the two spheres of the same size will fall with the same velocity under the action of gravity in the air, and therefore will fall through a given height in the same time.

(10343) J. H. R writes: I desire to purchase books which would thoroughly inform me upon the following case: A building is lighted with 23 incandescent lamps arranged in parallel. The current is supplied through a transformer which reduces the voltage from 2200 to 110. A man takes hold of the socket of one of the lamps and is killed. I want to be able to inform myself on the following questions: First, the precautions necessary in handling high-tension currents and where the danger points are. 2. The liability of transformers to leak, break down, etc., thus delivering the full voltage to the wire leading from it, etc. 3. What is the cause of death? Is it wattage, voltage, amperage, and what is the usual amount necessary to kill a person? Would the current coming from a transformer cutting it down to 110 volts and necessary to supply 24 incandescent lamps be sufficient? Would that supplied to one of these lamps be sufficient? A. Thompson's "Elementary Lessons in Electricity," price $1.40 by mail, contains as much as is given in any one book upon the topics concerning which you inquire. Rubber gloves and tools with insulated handles are necessary for handling wires carrying current above 110 volts. This pressure may have inflicted severe injury or even death in extreme cases, but we do not recollect any instance of death from it. In the case cited it would seem as if there must have been a connection with the primary of the transformer. Death is caused either by the shock of the current or by the disintegration of the vital tissues from its continued action on them. The amperes are the agent of electrolysis; the volts determine the amount of amperes which can flow through a circuit in proportion to its resistance, as expressed in ohms. The resistance of the human body is a variable quantity, from a few hundred to perhaps five thousand ohms. What current a man can get is not a question of the supply of one lamp or any number of lamps. It is a matter of the voltage of the current and the resistance of the body.

(10344) H. S. L. asks: 1. About an ink which can be used with a drawing pen upon zinc and which when dry or burned in will be acid-proof. A. Ink for Zinc Labels: Take 1 drachm verdigris, 1 drachm sal-ammoniac powder and ½ drachm lamp black, and mix them with 10 drachms water. This will form an indelible ink for writing on zinc. 2. A means for an amateur to impart a polish (high) to chestnut boards. A. Fill the wood with any good filler, let it dry, then apply a good varnish, two or three successive coats. Rub it down with powdered pumice stone, then with rotten stone, and finally finish with whiting, all in water. Apply with a felt or flannel rubber.

(10345) A. P. F. asks: 1. What would be the effect on a corrugated iron roof if lightning should strike it? Is it dangerous to the inmates of a house to use such material for a roof? A. If your corrugated iron roof is connected with water or moist earth at several points by heavy telegraph wire or small iron rods, it will serve very well as a lightning rod to protect the premises from being struck. If not connected to the earth, we think it is a source of peril. 2. Of what cheap material can we make a belt about 8 feet in length for light service, width 1½ inches? A. Belts are either made of leather or webbing. They must be inelastic, so as not to stretch in service. We do not know of any cheap substitute for regular belting.

(10346) A. B. D. asks: In applying gold leaf to sign work, what would be the sizing used? A. In wood signs use gold size. For glass signs use a thin solution of gelatin.

(10347) E. A. B. writes: I would be pleased to know by what chemicals or solutions blue prints may be changed from their original color (blue) to colors heretofore discovered? A. Blue Prints, to Change to Brown: Borax, 2½ ounces; hot water, 38 ounces. When cool add sulphuric acid in small quantities until blue litmus paper turns slightly red, then add a few drops of ammonia until the alkaline reaction appears and red litmus paper turns blue. Then add to the solution 154 grains of red crude gum catechu. Allow it to dissolve with occasional stirring. The solution will keep indefinitely. After the print has been washed out in the usual way, immerse it in the above bath a minute or so longer than it appears when the desired tone is reached. An olive brown of a blackish brown is the result. To Make Blue Prints Green: Make four solutions as follows: Solution A. Water 8 ounces and a crystal of nitrate of silver as big as a pea. Solution B. Hydrochloric acid 1 ounce and water 8 ounces. Solution C. Pour a solution of iodide of potassium (iodide of potassium 1 ounce and water 8 ounces) into a saturated solution of bichloride of mercury until the red precipitate is just dissolved, and then add four times as much water as the resulting solution. Solution D. Water 16 ounces and iodide of potassium 1 drachm. Then take the blue print and bleach it with solution A, when the image will become pale slate color or sometimes a pale yellow. Then wash thoroughly and immerse the print in solution B, when the image will again become blue. Then, without washing, immerse the print in solution C, when the image will become green but the "whites" will be of a yellow tint. Then put the print in solution B again, without washing. Then wash and pour solution D over the print to purify the whites and to give the green image a bluer tint; but do not leave print in this solution too long, as it has a tendency to make the print blue again.

(10348) C. S. asks: Please answer the following questions. I do not know whether the name is correct, but I have heard that selenium, a metal, changes its resistance to electricity when light strikes it. Kindly inform me about the price, the resistance it offers per square meter of surface, and whether the supposition that it increases its resistance when light strikes it is correct; also how sensitive it is. A. Selenium is not a metal, but an elementary substance which in its ordinary condition is a brittle solid of a glassy luster and fracture and a brown color. It melts at about 430 deg. Fahr., vaporizes at about 1300 deg., and burns with a blue flame, giving out an odor resembling that of putrid horseradish. Ordinary selenium is a very poor conductor, having an electrical resistance 37,500,000,000 times that of copper. When annealed for several hours at a temperature just below its melting point, with subsequent slow cooling, it forms a crystalline substance with a lower resistance. It is now sensitive to light. Its resistance is reduced, not increased, in proportion to the square root of the illumination; and also the effect is greater with a high electromotive force than with a low one. Narrow strips of annealed selenium are formed between the edges of broad plates of metal, so that the cross section is considerable, and thus the resistance is reduced while the area exposed to light is considerable. This is a "selenium cell." When the light strikes it, its resistance may be reduced as much as one-half. A cell whose resistance in the dark was 300 ohms dropped to 150 ohms in the light. Such a cell is not a generator of electricity, but a measuring instrument for determining the intensity of light.

(10349) A. L. V. asks: 1. Will you kindly explain the action of the inductor alternator, of the type *not* having a large cylinder at one end? A. The toothed projections upon the moving portion are called the inductors. The surrounding frame has projections of the same shape and size, which constitute the cores of the armature coils. When these two sets of projections are opposite each other, the magnetic reluctance is at the minimum and the magnetic flux through the armature coils is at the maximum. Similarly, when the inductors are in the intermediate position, the flux is at a minimum. Thus the current is produced without moving wire, or collecting devices, with their attendant risk of chafing and loss of energy by friction. See Sheldon's "Alternating Current Machines," price $2.50, by mail. 2. Why is it that, although the current from an X-ray induction coil is alternating, the discharge passes through the tube in only one direction? A. The secondary current in an induction coil is not alternating when the discharge points are drawn out so far that the spark passes only when the primary circuit is broken. The current then is a succession of impulses all in the same direction, the current produced by the making of primary current is suppressed, not being able to leap the gap. The X-ray tubes used with direct current in the primary coil are all energized in this manner. Their current is unidirectional and discontinuous, and not alternating. 3. In the 110-volt alternating-current system of incandescent lighting, why is it that, though the circuit is always complete through the primaries of the transformers, more power is required when more lamps are put in use on the secondary circuit? A. In any system of incandescent lighting by multiple arc, or parallel arrangement, when one lamp is on, the resistance is such that only the current required for that lamp can flow; when two lamps are turned on, the resistance is half of what it was before, and twice as much current flows. More power is therefore required of the generator. If no lamps were lighted, the generator would not be called upon for any current, and it would run free, offering no resistance to motion except the friction of its armature shaft. This is true of all dynamos, alternating or direct.

(10350) I. L. asks how to metalize insects so as to render them capable of coating by the galvanoplastic process. I have tried phosphorus and bisulphide of carbon, but find it very dangerous, as it is liable to burst into flames instantly. A. Dissolve 1 ounce of phosphorus in 1 pound of bisulphuret of carbon by frequent agitation. Add to this solution 1-3 pound of beeswax and mutton tallow 1-3 pound. Dissolve by gentle heat and guard against fire, as the mixture is very inflammable. To this add 1 pint of spirits of turpentine and 2 ounces of pure unvulcanized rubber dissolved with 1 pound of asphaltum in bisulphate of carbon. When the solution is complete, it can be applied to insects, flowers, etc., which are then dipped in a weak solution of nitrate of silver or chloride of gold. In a few minutes the articles are covered with a thin film of metal. They can be plated in the usual way.

(10351) E. H. writes: I have need of a resistance of 25 ohms in the form of a strip of German silver ⅝ inch wide, 24 inches long. How thick must it be, or what gage? If I should use it ½ inch wide, 24 inches long, what gage must I use? A. To get 25 ohms resistance with a strip of German silver ½ inch wide and 24 inches long will require that it be five millionths of an inch thick. If it be ⅝ of an inch wide, it may be a thought thicker. German silver has 13 times the resistance of copper. Hence a copper wire for the same size might be 26 x 2 feet or 26 feet long. And if 26 feet have 25 ohms, one ohm will be 1.04 feet long. Our wire table gives No. 39 wire as having 1.20 feet per ohm, which is near enough. Hence a German silver wire of the same size would have 25 ohms for a length of 2 feet. The problem then is to find the thickness of a plate whose sectional area is as great as a No. 39 wire, and whose width is a half inch. The diameter of the wire is 0.00353 inch. Its area is 0.00001 square inch. One half of this is 0.000005 inch.

(10352) R. R. S. asks: Why cannot the high-voltage alternating currents induced in the secondary of an induction coil be changed to direct currents and used the same as other currents of high voltage? A. The induction of an alternating e. m. f. is a necessity of the action of an interrupted direct current. When the primary circuit is made, the induced current in the secondary is in the opposite direction from the current which induced it, since that is the proper effect of an increase of magnetic flux upon the turns of the winding; when the primary circuit is broken, the opposite effect is produced, and the induced current is in the same direction as that of the current which induced it. The induction of an alternating current by an interrupted direct current is therefore a necessity. Now, as to the transformation of such an alternating current into a direct current. When a condenser is employed with an induction coil, the induced e. m. f. upon making the primary circuit is much weaker than that which is set up by breaking the circuit. Because of this fact, when the spark terminals of an induction coil are separated so far that the e. m. f. set up upon making the primary circuit cannot throw a spark across the gap between them, the spark passes only upon the breaking of the primary circuit, and the induced current is a direct current, acting by impulses, there being as many impulses per second as there are interruptions of the primary current at the vibrator or interrupter. This is the method in which induction coils are ordinarily used for experiments. If one would see the spark at making the primary circuit, he can produce it by bringing the spark terminals nearer together, till a spark is produced upon making the primary circuit. This spark is from positive to negative in the opposite direction from the spark upon breaking the primary circuit. No way has been discovered for using such an arrangement as a source of power or for lighting lamps, so that it can compete with the alternating-current dynamo, generating an electromotive force high enough for all practical purposes. Any transformer is operated at some loss, and the induction coil, throwing a spark through a wide gap of air, is not an economical transformer.

(10353) G. C. W. asks: An electric company charges for current 10 cents per kilowatt-hour. How many kilowatt-hours are required to run ten 110-volt 16 candle power lamps 10 hours? Also, how many for a 5-horse-power motor, 110 volts, and a 220-volt motor for the same time? A. A 16 candle power lamp at 110 volts may be assumed to take one-half an ampere, and thus use 55 watts per hour. Ten lamps will use 550 watts, and in 10 hours will use 5,500 watts, or 5.5 kilowatt hours, which at 10 cents per kilowatt hour will cost 55 cents. An electrical horse-power is 746 watts, 5 horse-power for one hour will use 3,730 watts, and in ten hours will use 37,300 watts, or 37.3 kilowatt hours. This at ten cents per kilowatt hour will cost $3.73. It is common to reckon 1 1-3 horse-power per kilowatt hour. If reckoned thus, the bill would be $3.75. The voltage does not affect the horse-power. If the current were supplied at 220 volts, the amperes would be halved, but the watts would be the same, and the bill calculated would be the same. The real bill as found from a meter might be very different from this. The motor does not run at best efficiency unless it runs at full load. If it is not using 5 horse-power, it takes more than the proportionate part of 5 horse-power to drive it; how much, it is not possible to say in general terms.

(10354) E. A. asks: During a rainstorm a click, and sometimes a very brief ring of a telephone bell is frequently audible, and is always coincident with a heavy stroke of lightning. It seems very evident that the click of the bell is due to the lightning being coincident with it, but how does the lightning cause the bell to click? A. The ringing of the telephone bell when a discharge of lightning occurs in its vicinity is explained by induction. The electric discharge affects the wire in the same manner as the discharge of a battery current through the wire would do. The magnet attracts the armature, and the bell rings. It is a frequent occurrence with both telegraph and telephone lines.

(10355) J. D. A. writes: On several occasions I have read in the answers to questions of your valuable paper, that lightning is due to atmospheric disturbances. I have also noticed that this theory is advanced in most of the electrical books that have come to my hands. Though it is undeniable that there must be some disturbance, yet such theory does not seem to me entirely satisfactory, for it is open to the question, What is the nature of such disturbance? I am of the opinion (and the more I study the subject the more I adhere to it) that lightning is caused by the heat thrown off in the sudden condensation of the water vapors suspended in the atmosphere; the condensation being caused by the atmospheric pressure, and taking place whenever said pressure becomes greater than the expansive force of said vapors. Is not this possible? I would like to know your opinion on this theory, either through the columns of your paper or otherwise. A. While the condensation of water vapor in the air may be concerned in the production of electrification of the water drops in the air, it is not easy to see how the pressure of the air can be any different from the pressure of the vapor of water in the same place in the air, unless the law of Newton is untrue, that action and reaction are equal. The production of a flash of lightning is not yet accounted for by any theory, and we shall have to wait for more knowledge than we have to explain this phenomenon.

(10356) C. R. McM. writes: I desire to maintain a heat of about 105 degs. to 110 degs. in a box containing about 8 cubic feet of air. Can I do it by sending a current from a small battery through wires? How many cells and what kind? How much wire and what kind? A. We cannot advise the heating of air by electricity if expense is an object. It will cost many times as much as an oil lamp, and be as difficult of regulation as that. It can be done, however, by a coil of No. 14 or No. 16 iron wire with three or four cells of battery. The bichromate cell will give the heat quickest. The Edison-Lelande cell also may be used. It will work slower and last longer. A bichromate cell will need to be renewed every day. The length of wire should be perhaps fifty feet. We cannot give definite figures, since there are so many circumstances to affect the result. If you get too much heat reduce the battery, if too little add more cells.

NEW BOOKS, ETC.

CONSUMPTION AND CIVILIZATION. By Dr. John Bessner Huber, New York. Philadelphia: J. B. Lippincott Company. Profusely illustrated. 536 pages; large 8vo. Cloth, $3 net.

In this book of over 500 pages Dr. Huber has produced a masterly and exhaustive treatise on the subject of Consumption. Every phase of the disease—including cause, prevention, and cure—is described in such an interesting and instructive manner that it cannot fail to prove attractive to physicians, invalids, and all persons who are interested in the prevention and cure of this disease, which is the cause of one-seventh of all deaths which occur in this and many other countries. Over 130 fine engravings are used to illustrate sanitariums, cottage and tent life, and many other subjects. Invalids and others will find much in this book which will assist them in the work of restoring their health.

PRODUCER GAS. By J. Emerson Dowson and A. T. Larter. London: Longmans, Green & Co., 1906. 8vo.; pp. 295. Cloth. Price, $3.

Within the last three decades the subject of producer gas and its application has come to take a most important position in engineering science. The authors of this book have been closely associated with the development of producer gas during all these years, and are exceptionally well qualified to produce a work of this kind. The subject is treated briefly and concisely, and the illustrations excellently supplement the text. The recognized position of producer gas in practical work to-day is such that it promises to be extended very widely in the near future. This being the case, mere rule of thumb is no longer applicable, and the subject must be considered theoretically as well as practically. While there are numerous books on the theory and practice of the gas engine, there is probably no complete work available at present on producer gas alone, and for this reason the volume in question is an acceptable addition to the literature of the subject.

THE CHEMISTRY OF HAT MANUFACTURING. By Watson Smith, F.C.S. London: Scott, Greenwood & Son, 1906. 12mo.; pp. 124. Cloth. Price, $3.

Mr. Shonk has very ably revised and placed before the public Mr. Watson Smith's interesting series of lectures on the Chemistry of Hat Manufacturing. These lectures were delivered before the Manufacturers' Association in the years 1887 and 1888, and notwithstanding that a considerable period has elapsed since their inception, they have had such influence in the remarkable progress of the British hat industry that their republication at the present time was desirable. The book should be of great value to those interested in work of this character, on account of its thorough and excellent treatment of the subject.

THE SCIENCE YEAR BOOK. By Major B. F. S. Baden-Powell. London: King, Sell & Olding, Ltd., 1907. Price, $2.

This year there are but few changes in the Science Year Book, and few were necessary, as those familiar with this excellent work will understand. Of course, the usual revision, necessary because of changes in conditions during the past twelve months, has been made, and the summaries of science have been combined in one general article—an arrangement which is probably more convenient than the prior one of separate headings. Those requiring a diary of large size, combined with a scientific summary, almanac, etc., should not fail to obtain a copy of the present volume.

MODERN PRACTICAL CARPENTRY. By George W. Ellis. New York: Industrial Publication Company, 1906. 4to.; pp. 390. Cloth. Price, $5.

This is probably one of the most ambitious books which has ever been written about carpentry. The ground is covered in as thorough a manner as is possible within the limits of one book, and the text is accompanied by nearly eleven hundred excellent engravings, which clearly illustrate the subject matter discussed. The book is intended for the use of workmen, builders, architects, and engineers, and describes methods of constructing and erecting roofs, floors, partitions, scaffolding, shoring, centering, stands, stages, coffer dams, foundations, bridges, gates, tunnels, excavations, and gives various structural details. It furthermore includes the necessary calculations in carpentry, and simple methods for finding the bevels in roofs and the similar problems encountered. The treatise upon timber, notes on the woods used in carpentry, and the tables and a glossary of terms and phrases connected with carpentry will be found extremely valuable. The chapter on the uses of the steel square is exceptionally good.

INVENTORS AT WORK. By George Iles. New York: Doubleday, Page & Co., 1906. pp. 503. Price, $2.75 by mail.

"Inventors at Work" is one of the most interesting and meritorious books of this character which it has been our pleasure to review for a long time. Mr. Iles has been most successful in his compilation of important inventions and the work of the foremost inventors, who have been of service in the advancement of civilization. The book is well illustrated, and is arranged in subdivisions covering various classes of inventions and innovations in different industries. It should prove of the greatest interest to the layman as well as the scientist and the inventor.

A GRAIN CHART. By R. G. Becker. Pittsburg. Price, $2.

This chart exhibits in an interesting and forceful manner various statistics concerning the grain production of the world, which will be found of value by all those interested in the subject. It includes the production of grains, including wheat, barley, rye, oats, and corn in the United States up to 1906; the wheat crop by States, the world's wheat crop, average yields per acre in the United States, Russia, Germany, Austria-Hungary, France, and the United Kingdom, and various other interesting statistics.

REINFORCED CONCRETE. By Albert W. Buel, C.E., and Charles S. Hill. New York: The Engineering News Publishing Company, 1906. 8vo.; pp. 499. Cloth. Price, $5.

The American practice and the prevailing conditions governing the subject in question are followed in this treatise, which is intended primarily for designing and constructing engineers. The first edition of this excellent book has made it familiar to many interested in this phase of engineering industry, and it needs little recommendation in this column. The second edition includes, in the appendices, tests of beams and columns made by Prof. Talbot, of the University of Illinois, and by the United States government at the Watertown Arsenal. Much of this valuable matter has not as yet been widely circulated, and its addition to the contents of the book will unquestionably enhance the value to its readers. The authors of this work are among the leading exponents of the American practice.

ALTERNATING CURRENT MOTORS. By A. S. McAllister, Ph.D. New York: McGraw Publishing Company, 1906. 8vo.; pp. 278. Cloth. Price, $3.

Dr. McAllister's excellent work on the alternating current motor is not intended for the beginner in electrical science. It has been assumed that the reader is familiar with the fundamental facts of electricity and magnetism, and that he has some knowledge of the lower branches of mathematics. The author deals freely with graphical diagrams and the examination of facts upon which they are based. The mathematical treatment of the subject is limited as far as possible throughout. The diagrammatical illustrations are very good.

GOLD MINING MACHINERY. By W. H. Tinney. New York: D. Van Nostrand Company, 1906. 8vo.; pp. 308. Cloth. Price, $5.

As the title indicates, this work deals exclusively with the principal features of the machines employed in gold mining; their sizes, capacities, speeds, and the rules and formulæ governing their use. The descriptions are brief and concise, but still sufficient to describe fully the machinery in question. The notes on methods of erection and other matters will be of practical assistance to mining and mechanical engineers. This work will be found a practical handbook for use by practical men.

TEXT-BOOK ON THE STRENGTH OF MATERIALS. By S. E. Slocum, B.E., and E. L. Hancock, M.S. Boston: Ginn & Co. 8vo.; pp. 314. Cloth. Price, $2.25.

While this book is thoroughly representative of the best modern theory and practice, it is sufficiently elementary in nature to be available for student use in technical and engineering schools. The text has been so prepared that the student's knowledge of the subject shall be accurate as well as practical, thus reducing the liabilities of errors from an incomplete conception of the foundations upon which the subject is based. Each important point is illustrated by practical applications. Graphical methods are used for calculating centers of gravity and moment of inertia, and the moment of inertia is defined as the shape factor in the mechanics of materials. Other important features are the use of the core section, application of the principle of least work, comparison of column formulas, with graphical illustrations of their relation, and accurate formulas for the torsion of shafts of various cross sections.

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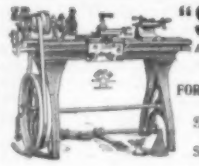

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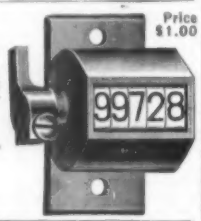

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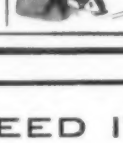

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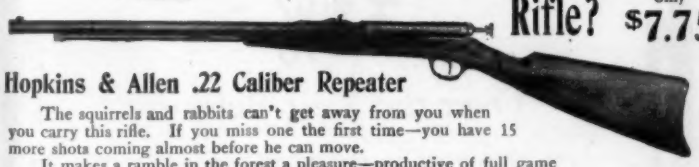

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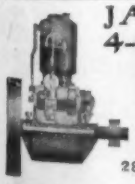

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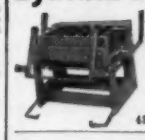

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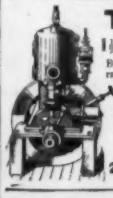

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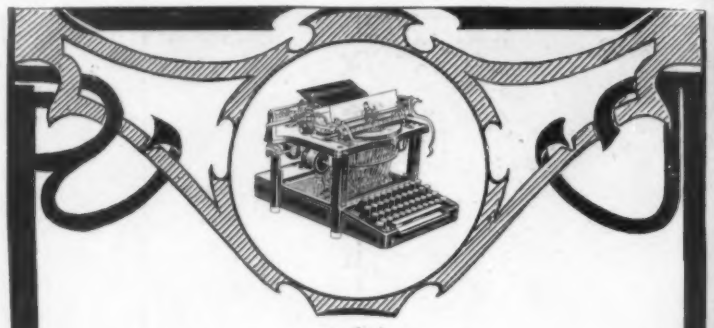

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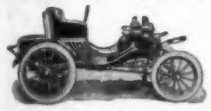

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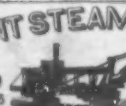

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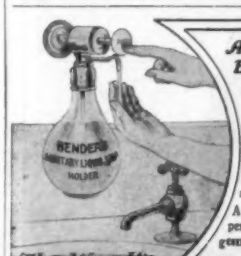

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